THE JOURNAL OF

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

· FEBRUARY · 1915 ·

THIRTEEN MEETING CENTERS

THE presidential address of Mr. James Hartness emphasized The Human Element in engineering, and in the development of this phase of the Society's activities, there is nothing of more importance than the meetings being held in various sections of the country. The Council is anxious to make these meetings of increasing interest and value and has appointed a Committee on Local Meetings, to coöperate with the officers of the Geographical Sections, which at present are:

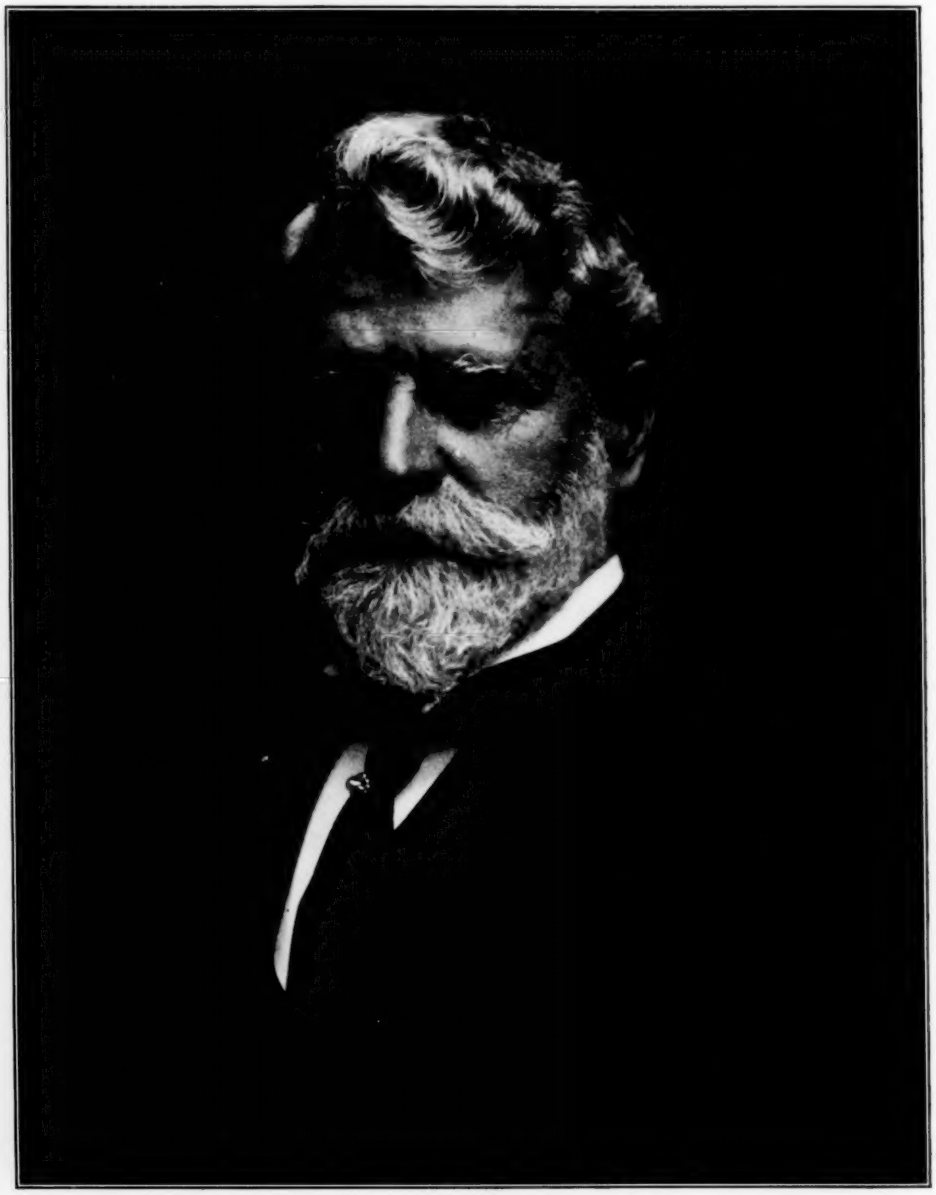
- Atlanta
- Boston
- Buffalo
- Chicago
- Cincinnati
- Los Angeles
- Milwaukee
- Minnesota (Minneapolis-St. Paul)
- New Haven
- New York
- Philadelphia
- San Francisco
- St. Louis

The members and engineers in general in various localities, where there are a sufficient number to warrant it, are encouraged to arrange for regular meetings. These may be in the nature of informal dinners at which technical matters can be presented and discussed. The expense of hall, lantern, printing, etc., will be borne by the Society. It is preferable that our sections coöperate with other engineering organizations, particularly if there is a local engineering society.

The successful development of new sections and of those now existing is dependent upon the interest evinced by the membership in securing the moral and financial coöperation of all well-qualified engineers in their respective districts. In all relations of life one obtains benefits in proportion to what one contributes toward progress and human uplift.

Total Membership of the Society, January 1, 1915....................6142

New Members enrolled in 1914....................................972



AMBROSE SWASEY, PAST-PRESIDENT OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, DONOR OF THE INITIAL GIFT TO THE ENGINEERING FOUNDATION, INAUGURATED BY THE UNITED ENGINEERING SOCIETY FOR THE FURTHERANCE OF RESEARCH IN SCIENCE AND ENGINEERING, OR FOR THE ADVANCEMENT IN ANY OTHER MANNER OF THE PROFESSION OF ENGINEERING AND THE GOOD OF MANKIND.

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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THE ENGINEERING FOUNDATION

On Wednesday evening, January 27, 1915, was held in the auditorium of the Engineering Societies Building the inaugural exercises of The Engineering Foundation, established by the United Engineering Society. The initial gift to the Foundation of $200,-000, made by Ambrose Swasey, Past-President of The American Society of Mechanical Engineers, was formally accepted at this time. So far as known this is the first instance of a foundation devoted to engineering purposes. This meeting constituted also an appropriate tribute to the generous gift made to the Foundation and gave opportunity for expression of the satisfaction and approval which are felt by engineers everywhere at the establishment of a means of promoting the good of mankind through the work of the engineer along the broadest lines.

Gano Dunn, President of the United Engineering Society and Past-President of the American Institute of Electrical Engineers, acted as presiding officer, and on the platform were seated representatives of the three societies constituting the United Engineering Society, and of the American Society of Civil Engineers. Members of the four societies and many other friends interested in the profession composed the audience.

The first address of the evening was made by Gano Dunn, who reviewed the history of the Engineering Societies Building, the purpose of the United Engineering Society, and the formation of The Engineering Foundation.

ADDRESS BY GANO DUNN

Mr. Dunn said that the United Engineering Society is a creation for the purpose of enabling three of the great engineering societies, The American Society of Mechanical Engineers, the American Institute of Mining Engineers and the American Institute of Electrical Engineers, to do jointly more than they could do separately. It is a corporation which holds in trust the property on which the Engineering Societies Building is located, the building itself, and its contents. The property and its contents were contributed by the founder societies, and the building by Mr. Andrew Carnegie. The interesting fact was pointed out that the celebration of the inauguration of The Engineering Foundation occurs almost exactly ten years from the date of the first meeting of the United Engineering Society, so that this occasion is partly a decennial. It is to be hoped that in the next ten years as much fruit will be born of the Foundation as the United Engineering Society has produced during the past ten years. The charter of the United Engineering Society contained among the other paragraphs describing its powers the following: "To take real and personal property by grant, devise or bequest, and use, maintain, occupy, lease, mortgage and convey the same." It was in the minds of the men who drafted this document that the time would come when the usefulness of the United Engineering Society would extend far beyond a corporation for owning and administering the building. But, said the speaker, ten years went by before that provision was made use of, and tonight we are together because a distinguished engineer, a man of marked intellectual power, a man of marked personality, has felt in his heart that he wanted to do what would most benefit not only the engineering profession but mankind, and believed that through the agency of the United Engineering Society it could be done.

We have foundations of many kinds,—for philanthropy, for civic betterment; foundations for many noble purposes seem to characterize American public life. But as yet we have to hear of a foundation in engineering. At last our turn has come, at last the human element is recognized among engineers in benefaction, and at last engineering is included among those human activities which are felt to be sufficiently important to promote.

The speaker explained that when the trustees of the United Engineering Society came to consider all the possible objects and uses to which a foundation could be put, they felt it could be best administered if in the hands of a responsible and distinguished board, separate from their own, with entire freedom

as to the expenditure of their resources. It was felt further that the work could never be successful or representative of the whole field of engineering if its roots were in only the three national engineering societies which constitute the United Engineering Society. Without the coöperation of the American Society of Civil Engineers, he said, "the pioneer society that we and all engineers have looked up to with honor and respect; the society from which we have taken our standards of conduct, the society whose numbers are more advanced generally in years, the society whose name we as engineers have loved to conjure with when we have been speaking with pride of the accomplishments of engineers—that society, we felt, must take part in the work of the United Engineering Society, or the work of the Foundation could not be expected to be successful. The structure of the Engineering Foundation, therefore, was so arranged that it should be managed by a Board of eleven members, of which the President of the United Engineering Society should be ex-officio one, two members from each of the founder societies, two from the American Society of Civil Engineers, and two from the world at large. In this latter provision the trustees hoped to introduce into the Foundation an outside element and a point of view that would forever save the Board from becoming narrow, and would likewise inspire new ideas." The speaker said that in his opinion they never did so wisely as when they called upon the world in general to share with them in administering this great trust.

Mr. Dunn said that in proposing this structure to our sister society and inviting them to share in the management of the trust, a letter of acceptance was received which the trustees felt insured that the future of The Engineering Foundation would be a brilliant one. After consideration on the part of its officers and its official board of direction, the American Society of Civil Engineers replied as follows:

I have the honor to state that your letter of January 5, 1915, was presented to the Board of Direction of this Society, together with the Amendments to the Charter and By-Laws of the United Engineering Society, which provide for The Engineering Foundation, and that the action of the undersigned in the matter up to that date was approved.

I am instructed further to say that the American Society of Civil Engineers is very glad to become one of the four societies to be represented on the Board in whose hands the administration of The Engineering Foundation is to be placed.

I am instructed also to express to you, and through you to all who have been interested in this matter, and especially to the donor of the present endowment, the appreciation of the Board of Direction of the American Society of Civil Engineers of the courtesy which has been extended to the Society in giving it the opportunity to participate in this movement.

Yours very truly,
(*Signed*) CHAS. WARREN HUNT, *Secretary*.

In conclusion Mr. Dunn said:

"This structure was created at this time because of the urging of the donor, whose name I have not mentioned, but whose personality I have indicated, and now that I have described it, I should like to announce what he has done, and who he is. In doing this, I again wish to comply with his request that his part be made as small as possible, and I must say that this on my part, is a perfunctory compliance, because, while he undoubtedly wishes it so, we can never forget how large is the part he has played not only in giving this endowment, but in initiating and creating the structure that undoubtedly will be the receptacle of many future endowments, and the center and source of much important work in the future."

This is the letter:

DEAR PROFESSOR HUTTON: I am pleased to acknowledge receipt of yours of the 20th instant, also copy of the minutes of the Board of Trustees of November 19, and I appreciate the courtesy of the Board in submitting them to me before final approval.

The name adopted, "The Engineering Foundation," is ideal, and the plan of organization and administration, as given in the minutes, is along the broadest lines and most admirable in every respect. I have no suggestions or recommendations to offer.

As soon as I am advised that the plan of organization of The Engineering Foundation submitted has become the law of The United Engineering Society, I will be pleased to transmit to the officer designated by the Society, the two hundred thousand dollars ($200,000) which constitutes my gift to the Society for The Engineering Foundation; the income only of which is to be used for the purposes of the Foundation.

As to the date of the general meeting when the plan of the Foundation is to be made public, if agreeable to the Board, it seems to me it would be well to have it some time during the last week in January.

I want the members of the Board to know how much I appreciate the interest they have manifested in working out the problems relative to the Foundation, and the pleasure it has given me to be associated with them in their splendid undertaking.

With all best wishes,
Very truly yours,
(*Signed*) AMBROSE SWASEY.

REMARKS BY AMBROSE SWASEY

Mr. Swasey was then called upon by the Chairman and very briefly expressed his appreciation of the cordial manner in which the announcement had been received. He believed that the meeting was also evidence of the appreciation felt of what had been accomplished by the United Engineering Society and the work which they had done in planning and bringing about this Foundation. It is a very simple matter to throw a few shovelsful of coal under the boiler, he said. We must have fuel if we would have power. But to the engineers who designed the boiler and the engine, and who so proportioned them and so correlated them that the products of combustion can be used to greater advantage than ever before for the benefit of mankind, the greater credit belongs.

ADDRESS BY ROBERT W. HUNT

Robert W. Hunt, Past-President of the American Institute of Mining Engineers, paid a personal tribute to Mr. Swasey, as a lifelong friend, and said that it is

one of the few certainties of this world that the greatest earthly happiness comes to those who have made others happy. The United Engineering Society, which will administer this Foundation "to develop, direct and conserve the forces of nature for the benefit and uplift of mankind through the instrumentality of the engineer," was made possible by the generosity of one man, Andrew Carnegie. He wisely surrounded his gift made in recognition of the profession and the men who had made possible his own financial success, with conditions which required efforts and contributions from others, and also, as became a true humanitarian, did not make the institution a personal one. As a result engineers in every department of the profession, as well as all believers in engineering, have united in making the proposition successful, entirely ignoring self.

This Foundation is the conception of one man who does not seek individual aggrandizement, but rather through his own munificence to create a base upon which others can unite with him in building a structure which will benefit all humanity. This structure will not be his nor any other man's, but to each one who may hereafter add to its growth and usefulness will be given the happiness incident to helping to uplift mankind. This is no new rôle to Mr. Swasey, to whom all human beings, whether they have the yellow skin of the Far East or are the laboring boys and men of his own country, are fellow-mortals. While he built telescopes to comprehend in part the incomprehensible universe, his love for and his desire to serve his fellow men has grown and has manifested itself in many ways.

Mr. Hunt related an incident of Mr. Swasey's successful fight for the new post office building in Cleveland, which was finally built, as a result of his efforts, of granite instead of limestone. This was but an instance of Mr. Swasey's many unselfish efforts for public welfare. Many of his works of benefaction were known only to a few. He spoke also of his lifelong friendship with Mr. Swasey and said that in the starting of this project Mr. Swasey was only opening the way and making it practical for others to give.

ADDRESS BY HENRY S. PRITCHETT

Dr. Henry S. Pritchett, President of the Carnegie Foundation for the Advancement of Teaching, spoke upon the significance of the gift and its meaning for engineering science and civilization. Great numbers of research institutes already exist in Europe and America, but never has such an agency for research been placed in the hands of a group of engineering societies. The word research has become almost a shibboleth in university circles; but it must be confessed that a great proportion of this is the imitation, not the reality. In the sense in which it is used in this Foundation, he thought, it means the attempt to formulate and solve those problems of science which touch most directly the comfort, the happiness and the progress of the nation and of the world. In this process it requires quite as high an order of ability to formulate the problem clearly as to solve it.

"Research considered as a process of scientific thinking and discovery is not a task to be set before the immature and the untrained. It is quite true that the best training for research may not always lie in university halls. A long roll of illustrious men whose names the world cherishes found their way to the solution of the great problems of science and of industry by other paths than the university. This means simply that they became thinkers in their own way.

"The process of research, therefore, as one may expect it to be carried forward by such an agency as this, involves first the clear formulation of problems, and then the attack upon the problem by all the avenues and by all the agencies of science; and this process, it may well be assumed, will be successfully carried out only by those men who have learned to think, who are familiar already with the present state of science, and who—using this as a basis—push forward the boundaries of our knowledge into new fields. True research implies clear thinking, minute knowledge of the field of science, and patient endeavor.

"The development of such a research agency by the great engineering societies, through a fund entrusted to them, has, to my thinking, far reaching significance, first, for engineers themselves; secondly, for research; and in the third place, for the public, the great body of citizens.

"So far as engineers themselves are concerned, the offer and acceptance of this foundation signalizes the fact that engineering in America is to-day a profession, not a business. For two centuries and more the civilized nations have recognized three great professions—that of the law, of medicine and of the clergy. Only within our generation has engineering been admitted to the fellowship of this group; and it has come because the world now recognizes that the man who serves in the field of applied science, if he serve in the right spirit, gives a part of his energy to the service of the public. It is in just this respect that business differs from a profession. Physician and lawyer and clergyman accept pay, but in each of these professions it is clearly recognized that the service must not be governed by the pay, that a large part of the energy of the profession must be given to the service of the common good, that members of a profession occupy a quasi-public relation. Only when the men of a calling attain this sense of professional consciousness can the calling pass from that of a business to that of a profession. The members of a vocation who take upon themselves the responsibility for the direction and encouragement of scientific research have risen out of the business of engineering into the profession of engineering.

"With regard to research it may be said that, while engineering research in its essence partakes of the nature of all research, it undertakes to formulate an answer to certain questions which are not likely to be dealt with successfully elsewhere. Ever since universities and institutes for research have existed there has gone on the discussion between what is called theory and what is called practice. As Professor

Pupin has well put it, 'It is the practice which formulates the question; theory seeks to answer it.'

"It is the man in the practice who formulates the question. It is the scientist who finds the answer.

"The criticism of university research has been that theory and practice, the man who formulates and the man who solves, have not always been happily related. In a research agency conducted by associations of engineers there ought to be the most fortunate alliance of theory and practice. Here, the practitioner who questions and the man who seeks to solve, the man who formulates and the man who delves ought to find their closest association. And it will be interesting to observe how, under such auspices, theory and practice will learn to go hand in hand.

"To the public the foundation of such a research agency in the field of applied science may well mean the inauguration of a series of studies having the greatest significance for public well-being and for public needs. The most striking illustration of such a result has been already given in the history of a small research laboratory of applied science, started in the technical school, at Charlottenburg, some forty years ago. The effort arose out of the questions formulated and laid before the scientific staff of the techinical school by the men of the steel industry; and out of the solutions of these questions the steel industry of Germany grew. Gradually the inquiry arose, why should there not be an institute of engineering research to which any citizen engaged in the industries may bring his problems? to whose laboratories may be brought not alone the questions relating to the manufacture of steel, but those relating to the chemical industry, textile industry, electrical manufacturing and industries of every sort, in a word, all the questions which to-day in the manufacturing establishments of a great nation are constantly being asked?

"Out of the little research laboratory at Charlottenburg have grown the great testing laboratories (Versuchtanstalt covering many acres and offering themselves freely to the solution of every technical question that the industries in Germany can present. Any company engaged in the industries may bring its problems here. Any experts may come in and take part in the study, all the literature on the subject is made available, and under the combined efforts of the expert of the government laboratory and the experts of the industry a solution is generally found.

"The process is illustrated by the story which a paper manufacturer in Berlin told to me some years ago. His company manufactured wood pulp from the forest of a certain region. A change was made and their wood supply was drawn from another region. The formulae they had hitherto used no longer sufficed, and despite every effort of their own no solution had been found. Financial ruin stared the company in the face. The problem was carried up to the government laboratories of engineering research. At the end of two months all difficulties had vanished and prosperity returned to the manufacturer.

"Dr. Martens, the director of the research institute at Grosslichterfelde, told me that the complete and orderly collection of scientific literature and of scattered scientific solutions in research made available at Grosslichterfelde was one of the great factors in the success of the research establishment. 'Four times out of five,' said he, 'when a manufacturer brings us a problem we find that it has already been solved somewhere in the world by somebody, but by someone who generally used the solution in a different connection. Our greatest service is to place at the disposal of the inquirer the entire literature of his subject, and in this he will generally find a solution of his question already made.'

"Who can tell but that this modest agency for research, under the direction of the great engineering societies of America, may develop in due course into a national establishment to which any man in the industries may bring his problem with full hope of solution?

"We found here to-night an agency for human uplift and human development. It is founded not in brick and mortar but in the living engineers of these great engineering societies, which shall go on from decade to decade and from generation to generation. If our civilization endures, this association of engineers will develop with the ages. They will never die. And in their hands this agency of research will also be immortal, serving humanity from century to century and from age to age.

"It has been founded by an engineer at once wise and modest. To have founded such an immortal agency for human endeavor is to become oneself a partaker in immortality."

REMARKS BY CHARLES MC DONALD

Following the address by Mr. Hunt, the Chairman called upon Mr. Charles McDonald, Past-President of the American Society of Civil Engineers, saying that if The Engineering Foundation had no other virtue than to bring into closer unity the four great engineering societies, it would have accomplished results of greatest value.

In response Mr. McDonald said that the American Society of Civil Engineers welcomed the efforts to be made through this gracious gift to The Engineering Foundation. His society would be glad to coöperate in working for the general good of the profession. No matter what organization he was representing, he wished to be considered at this time as a member broadly of the whole profession.

REMARKS BY ALEX. C. HUMPHREYS

Dr. Alex. C. Humphreys, Past-President of The American Society of Mechanical Engineers, then formally accepted Mr. Swasey's gift in behalf of the Board of Trustees of the United Engineering Society. He quoted the by-law of the Society which covered the administration of such a fund and which reads as follows:

The Engineering Foundation Board shall have discretionary power under the By-Laws in the disposition of the funds received by it.

The Board may use any part of its funds and in any manner, which it deems proper for the furtherance of research in Science and Engineering, or for the advancement *in any other manner* of the Profession of Engineering and *for the good of Mankind*.

The Board may, by publication or public lectures or *by other means*, in its discretion, make known to the world the results of its undertakings.

This By-Law, he said, had been written in an effort to interpret Mr. Swasey's broad-minded and self-effacing intentions.

The acceptance of the fund, he said, meant the acceptance of a grave responsibility, which would, he believed, be met with the full determination on the part of the representatives, present and future, of the four societies to administer this fund and additional contributions in the interest of the larger needs of mankind. He hoped that the Foundation in its activities would always stand for the truth, the whole truth and nothing but the truth.

AMBROSE SWASEY

Donor of the Initial Gift to the Engineering Foundation

Ambrose Swasey is widely known as a member of the firm of Warner & Swasey of Cleveland, Ohio, prominent machine tool builders and the foremost builders of telescopes in the world. Among the instruments which they have designed are the famous Lick, Yerkes, and United States Naval Observatory telescopes, as well as the great 72-inch reflecting telescope for the Canadian Government, which is now under construction. Mr. Swasey is known also, in addition to his engineering achievements, for his practical efforts towards scientific education and the advancement of the profession. His gift for the establishment of The Engineering Foundation is in line with these undertakings, which may be destined to outlast his fame as an engineer. Mr. Swasey gave the handsome observatory to Denison University at Granville, Ohio, and the science building for the University of Nanking and the Young Men's Christian Association Building for the Canton Christian College now being erected in China, were made possible through his gifts. He has also, as president of the Warner & Swasey Company, interested himself earnestly in the establishment and conduct of its school of apprentices, and indeed the weight of his influence is to be found in every project tending to the development and encouragement of the human element, helping men to help themselves.

Dr. John A. Brashear, a life-long friend of Mr. Swasey, gave the following account of Mr. Swasey's life in an article which appeared in Cassier's Magazine for March 1897. The whole article, which cannot here be reproduced because of lack of space, is well worth reading as the tribute of one eminent astronomer to another.

"Ambrose Swasey was born in Exeter, N. H., his ancestors being among the early settlers of New England, coming to America in 1638. He received his education in the 'Little Red School House' of the district, and his after life has shown that the seed sown by the old schoolmaster fell upon good ground. At the age of eighteen he entered upon the machinist's trade in Exeter, and in 1870, in company with his present partner, Mr. Worcester R. Warner, he left the granite hills of his native State to go into the employ of the Pratt & Whitney Company, at Hartford, Conn. His energy and ability soon became manifest to his new employers, and his aptness in the solution of mechanical problems was so thoroughly appreciated, that the remark, 'Send it up to Swasey,' was a common one with them.

"While in charge of the gearing department, he invented and perfected the epicycloidal milling machine for producing the true theoretical curves of the teeth of gears, and a few years later he made another advance step in the solution of that difficult problem, inventing an entirely new process for generating and cutting spur gears, which proved a practical solution of the very important theory of the interchange system of gearing. In 1880, Mr. Swasey resigned his position with the Pratt & Whitney Company and, together with his present partner, established in Cleveland, O., the business which has since grown to such large proportions. Mr. Swasey's inventive and mechanical genius has emphatically manifested itself in the design and construction of the fine machine tools and astronomical instruments made by his firm.

"It seems a most fortunate circumstance that these two men, Ambrose Swasey and Worcester R. Warner, should have associated themselves together as partners, for although the making of astronomical instruments was not in their original scheme when starting the business of machine construction, Mr. Warner's taste for astronomy, and his interest in the appliances used by astronomers, combined with Mr. Swasey's love for artistic design, and his ability as a mechanical engineer, naturally led them to take hold of the questions pertaining to such instruments.

"In recent years observatories and instruments had increased to such dimensions in America that most intricate problems, requiring the highest engineering skill, were demanding solution. The largest refracting telescopes constructed previous to 1880 were the 26-inch telescope of the United States Naval Observatory, at Washington, D. C., the 27-inch of the University of Vienna, Austria, and the 30-inch instrument of the Pulkova Observatory, Russia; but the Lick telescope, as projected, was to have nearly half as much more light-gathering power than any refractor that had hitherto been constructed, and the difficulties of mounting such an immense instrument are enormously greater than those attending the construction of a smaller one.

"In 1886 the Lick trustees invited four firms to submit designs for the 36-inch telescope, which was to be the largest and most powerful ever constructed. Two of the competing firms were from abroad and two from the United States. . . .

"The competing designs for this great telescope were sent to the Lick trustees in San Francisco, and after careful consideration the plans submitted by Messrs. Warner & Swasey were accepted, and they were awarded the contract, although their price was the highest. The design of this important instrument was carefully studied in every detail, and the highest standard of excellence was maintained throughout. It was finally erected on Mount Hamilton, in California, during the winter of 1887 and 1888 under Mr. Swasey's personal supervision."

This instrument was very naturally subjected to much criticism, but it stood all the tests and when the Government desired to reconstruct the Naval Observatory at Washington in 1890, the Warner & Swasey Company were given the contract for the 26-inch telescope; and they were also later entrusted with the task of making the 40-inch telescope, and also the 90-foot dome and the 75-foot elevating floor, for the Yerkes Observatory, Williams Bay, Wis.

The manufacture of meridian circles, transits and other astronomical instruments of extreme accuracy and precision has formed a large part of the firm's work, and in the designing of all these instruments Mr. Swasey has taken an important part. For graduating the fine circles of these delicate instruments, it was necessary to have a circular dividing engine, and as there was no instrument in the country of sufficient accuracy, the problem was taken up of designing and perfecting such an engine which, when completed, was capable of dividing circles automatically up to 40 inches in diameter with an error of less than one second of an arc, probably the most accurate circular dividing engine ever constructed.

Mr. Swasey is the inventor of a number of instruments used by the Government in its coast defense, including several improvements in the construction of range finders.

Many honors have come to Mr. Swasey for his work and achievements. He is a past-president of the Society, a member of the Institution of Mechanical Engineers of Great Britain and of the British Astronomical Society, he is a Fellow of the Royal Astronomical Society, is past-president of the Cleveland Engineering Society, and, in 1900, received from the French Government the decoration of The Legion of Honor for his achievements in the design and construction of astronomical instruments. He was a member of the Jury of Awards of the Nashville, the Pan-American and the St. Louis Expositions and Vice-President of the Jury of Awards of the Jamestown Exposition. In 1905 he served as president of the Cleveland Chamber of Commerce, and the same year the degree of Doctor of Engineering was conferred upon him by Case School of Applied Science. Mr. Swasey was married October 24, 1871, to Lavina D., daughter of David and Sarah Ann (Dearborn) Marston, and he and Mrs. Swasey had traveled extensively up to the time of Mrs. Swasey's death early in the year of 1913.

TESTIMONIAL DINNER TO AMBROSE SWASEY

The President and Trustees of the United Engineering Society tendered a testimonial dinner to Mr. Ambrose Swasey, Past-President of The American Society of Mechanical Engineers, at the University Club, Tuesday evening, January 26, 1915.

There were present the members elect of the Board of Trustees of the United Engineering Society, the presidents and secretaries of the four national engineering societies and the Engineers' Club, the speakers at the inauguration of the Foundation on Wednesday, a group of other friends in the several societies who had been conferring with Mr. Swasey in the development of the Foundation, and the benefactors of the founder societies.

Impromptu addresses were made by John Hays Hammond, E. D. Adams, Charles F. Scott, and T. A. Rickard of London, member of the Iron and Steel Institute, editor of the Mining Review of London and the Mining and Scientific Press of San Francisco. Mr. Rickard commented on the status of the progress of the professional engineer in relation to the status of members of the other professions, of law, etc. Dr. H. S. Pritchett also spoke of the enduring features of a foundation administered by an engineering society which would go on from generation to generation and from century to century. Dr. M. I. Pupin spoke of the opportunities of useful service which this Foundation could render. In conclusion, Mr. Swasey himself made a few remarks, saying that his contribution was only the beginning and that it was his hope that engineers generally would make further contributions. The final greeting to Mr. Swasey, all members of the dinner rising to their feet, was a vow similar to that made by the signers of the Declaration of Independence: "For the support of this Declaration, . . . we mutually pledge to each other, our lives, our fortunes and our sacred honor."

COMMENTS ON THE ENGINEERING FOUNDATION

As the first endowment to be devoted to the advancement of engineering, much interest has been aroused as to the purposes for which The Engineering Foundation will be expended. Mr. Swasey in making the first gift to the Foundation, wisely and characteristically made no stipulation as to the method of its application, and there has as yet been no announcement from the Board which will administer the fund.

A number of members of the Society and others interested in engineering have been asked to express their opinion upon the value of this Foundation and to make any suggestions they may have as to how it may best

be applied. Quotations from their replies are given herewith. None of these embody any official statement, but will be interesting nevertheless as representing various viewpoints.

The replies follow:

My opinion of the significance of the Foundation is well expressed in a wire which I have formulated to send to Mr. Swasey on the morning of Wednesday, the twenty-seventh. It is as follows:

"My dear Mr. Swasey: This is a significant day. By your thoughtful and generous action, it introduces a process whereby new truth will be revealed, engineering practice will be improved, industry will be stimulated and the progress of mankind advanced. Pray accept from me, a humble worker in the ranks, expressions of sincere appreciation and renewed assurances of personal admiration and esteem. May God bless you and give you satisfaction and joy in the foundation you have created."—W. F. M. Goss.

The Engineering Foundation established by the United Engineering Society, to which Mr. Ambrose Swasey, Past-President of The American Society of Mechanical Engineers, is the first contributor, marks a new point of departure in the advance of the Engineering Profession.

Not the least important feature of this very important undertaking is the enlistment of the interest of the four national societies of Civil, Mining, Mechanical and Electrical Engineers in a common cause for the advancement of the Profession.

What Mr. Swasey has done others may be encouraged to do when it has been shown that The Engineering Foundation is being administered upon broad principles and the results obtained are of value and are given free to the Engineering Profession of the world. The success and the power for good of this great undertaking devolves upon The Engineering Foundation Board.—Jesse M. Smith.

I am delighted to know of the inauguration of The Engineering Foundation and I congratulate the profession not only on the possession of such an aid for the advancement of the arts and sciences connected with engineering but on having in its ranks one who is willing to aid in the work of benefiting mankind. I feel that such a foundation would have a wide field of usefulness in making grants to aid in investigations which are being made or which should be made. A little aid at the right time may help many to finish work which would remain unfinished without this. I am sure that great good will result from The Engineering Foundations.—Arthur M. Greene, Jr.

A natural use for the income of such a fund would be the carrying on of researches along mechanical lines through committees of the Society, in such a way as to add to the fund of engineering knowledge. As an illustration, such work as Mr. F. A. Halsey is proposing to do, when financial backing can be secured, in connection with the testing of worm drives and the action of worm wheel and spiral teeth, would seem to come directly in the class mentioned.

Also, such work as is being done by the various committees of the Society; for example, our Committee on Screw Thread Limits and Tolerances has suggestions in mind as to methods of gaging and measuring screws, so as to determine simultaneously the errors of lead and diameter. If funds were available to produce such gages and actually make a trial of them, more tangible results would follow than are possible at the present time.

It goes without saying that there would have to be careful guarding of the use of such funds as they would easily be dissipated in useless experiments and for side issues which would not materially advance the arts and sciences connected with engineering.—Luther D. Burlingame.

In my opinion the most important matter now required to advance the science of engineering, to place it on a high plane as a profession, and to facilitate the work of research in engineering, is the maintenance and publication at frequent intervals of a catalogue with abstracts of all engineering literature. This collection of abstracts should be similar to the abstracts made and published in the publication known as Chemical Abstracts; it should be so well indexed and furnished with cross references that a man interested in any one subject would quickly and accurately secure an abstract of all the articles that appear on that subject. It should be so complete that a patent attorney might use it for looking up the state of the art and rest assured that he would miss nothing within the period covered by the publication. It should be checked up at the end of every year with all the various indexes published, in order that it might be found that nothing had been missed. The abstracts should be made by technically trained persons and not by trained librarians.

They should be sufficiently comprehensive to give a man a very accurate idea of what the article contains, so that he can determine, for himself, whether or not it was worth his while to read the whole article, but should avoid all repetitions and unnecessary language. It should be so accurate as to remain the standard for this kind of work, and it should cover publications in the language of every country likely to interest engineers. It should be so practical that no engineer, who pretends to keep in touch with the progress of his profession, could afford to neglect to read it as promptly as it appeared.

In case such an index could be maintained it would be entirely unique among abstracts of this kind and would be a boon to the profession of engineering whose value it is impossible to over-estimate. The work should be done, however, in coöperation with other institutions that are making abstracts, in order that such collaboration might lessen the labor of all—Bradley Stoughton.

My judgment would be to utilize practically all of the income in paying the salary of a director, with enough off to provide for a stenographer and a minimum of other expense, such as printing.

There are a thousand different minor researches that might be carried on for the advancement of the arts and sciences connected with engineering and which perhaps would bring about some slight benefit to mankind, but I believe the biggest return that could be obtained for the amount at present available would be to put in charge of the Foundation a man of sufficient calibre to bring his good offices to bear on the coördination of such engineering research as is now being carried on and further to really find out about and keep in touch with what is now being done.

The standing of the Foundation in the community is going to be very largely determined by its early activities and it seems to me that the best impression on the community would be made by one strong man.—M. L. Cooke.

I cannot speak too highly of the generosity, public spirit, and devotion to the profession of that splendid man, Ambrose Swasey, through whose munificence the creation of The Engineering Foundation is due. As to the direction in which this fund could best be devoted to benefit the engineering profession and the human race, in my opinion the greatest need of the engineering profession today is neither more literature nor more scientific experiments to accumulate data, but a better appreciation by the public, which employs engineers, of what the engineer can do, coupled with a clearer understanding of the proper method to be adopted in engaging an engineer to undertake a particular piece of work.

Few engineers in active life who are in close touch with present day conditions, have the leisure to undertake a broad investigation of this sort and study out possible plans of action. An organization such as The Engineering Foundation, however, could employ and pay an engineer, and a competent staff, if necessary, to investigate this whole matter, and make it his business to find a solution as he would find the solution for an engineering problem.

It will, of course, be admitted that the ideal of placing an engineer perfectly equipped for his task in charge of every important piece of engineering work in the country is an ideal impossible of attainment. When one is aware, however, of the many million dollars which are spent in ill-advised and unwise work every year by cities and towns and private corporations, he cannot but feel that if the work were done by better engineers, far better results would be secured. Certainly no other subject compares with this in the interest it is now arousing in the engineering profession everywhere. All sorts of proposals are made and discussed by individual engineers and by engineering societies. An authoritative investigation, made by an organization representing all the national engineering societies, would be of value to every member of the engineering profession and could hardly fail to place the profession on a better footing before the public.—Charles Whiting Baker.

As a civil engineer by profession, I rejoice heartily in the good fortune which has thus come to the united engineering societies, and I feel that my best thought must be given to the request you raise irrespective of publicity. This latter, especially as it is exemplified by the press, does not interest me. I shall be glad, however, to give your association, as I am giving many others, the best counsel available to me, and give it as a silent partner.

I regret very much that I may not be with your company tonight, to indicate by my presence the high regard in which I have long held our friend Swasey, and the delight which his gift to the engineering profession brings to me.—Robert S. Woodward, *President, Carnegie Institute.*

I am very glad that someone has at last remembered the engineers and I believe a great deal of good can be done with the money already given.—Charles S. Howe, *President, Case School of Applied Science.*

The great question of the hour is a national technical efficiency. I do not mean a mere professional education, such as the efficient bookkeeper receives, but a general training, starting in boyhood and producing a high technical efficiency on the part of the individual that will prove a bulwark to him throughout life and forever relieve him from any anticipation of want through incompetence to earn a living.—Geo. F. Kunz.

Two great objects of the engineering societies are education and research. Both of these objects are worthy of the expenditure of vast sums of money and of unlimited amounts of energy. The Foundation now established will, I hope, increase in amount and magnitude in the future until the available sum is sufficient to undertake great achievements both in education and in research. The great need of the engineering profession is scientific research conducted with no regard to commercial results and without any influence from commercial organizations. Numerous fields invite study, consideration and investigation, and it is suggested that in the line of research alone the income of the foundation could be employed in such a way as to accomplish much to advance the engineering profession in its place of responsibility and contribute to the welfare and uplift of mankind.—R. C. Carpenter.

Only two things occur to me: first, I believe a scholarship would be a good thing, similar to the Whitworth scholarship in England, that is restricted to regular apprentices; second, a first class library bureau which would be free to the members of the various societies. Such a library bureau should not only give references to the members on subjects they require but should attempt to coördinate the vast amount of valuable information that is constantly appearing in our technical press. Any number of mistakes occur in engineering work, not because they have not been made before, but because there is no quick method for the men engaged in the work to obtain information.

For instance, I have been up against a problem of drawing cartridge cases and a comprehensive report on this art would be of the greatest value to me. I do not want references to a large number of periodicals; I would want the subject drawn off from the different sources of information in such a way that the information would be readily useful to me, with perhaps a reference to certain standard works on the subject, which would be found in any reasonably well organized technical library.—H. H. Vaughan.

It has always seemed to me unfortunate that there is in this country so little coöperation between those engaged in engineering and in the so-called pure sciences. The distinction should not be between those who do useful things and those who do things the practical applications of which are not obvious, but between those who discover new ways of doing things and those who follow the old ways. It might consequently be desirable for The Engineering Foundation to make plans that would secure coöperation between engineers and mathematicians, physicists, chemists, pathologists and other scientific men.

The British Association makes appropriations to committees which are to a certain extent responsible for work usually done by one or two members. If The Engineering Foundation should adopt this plan, it would be possible to appoint committees representing different aspects of engineering and science.—J. McK. Cattell, *Editor of Science.*

No subject of greater importance could demand the attention of The Engineering Foundation than that of an investigation of the subject of building a house for man. This house to have the following points: Extreme durability; no wood whatever, consequently incombustible; specially designed for fewest motions in connection with housekeeping; and specially designed for the elimination of unnecessary fatigue and sickness. Such houses can be built—no two alike—for less money than the individually designed houses of the present time, eliminating the tremendous loss to our country (due to fire), fire insurance, and fire protection. I have been working on this subject for several years in my spare time, and I know that it is a most needed philanthropy—that will at the same time make a good permanent return on the investment. (No great philanthropy will be permanent unless it pays.)—Frank B. Gilbreth.

COUNCIL NOTES

At a meeting of the Council on January 8, 1915, Prof. Arthur M. Greene, Jr., was appointed to represent the Society on the Conference Committee of the engineering societies, to fill the vacancy caused by the death of Alfred Noble.

The following appointments on Standing Committees were announced by the President: Finance Committee, A. E. Forstall; Committee on Meetings, L. P. Alford, reappointed; Publication Committee, Henry Hess; Membership Committee, George A. Orrok; Library Committee, Jesse M. Smith; House Committee, O. P. Cummings; Research Committee, R. J. S. Pigott, A. M. Greene, Jr.; Public Relations, Spencer Miller; Constitution and By-Laws, James E. Sague. A new feature of appointments may be noted in that there is a member of the Council now on each of the Standing Committees, thus correlating the work of the Society and the Council.

A Committee on Local Sections, E. H. Whitlock, Chairman, W. F. M. Goss, L. C. Marburg, Walter Rautenstrauch and D. Robert Yarnall, was also appointed.

Appointments on local committees were approved as follows: Boston, C. W. Clark; Cincinnati, George Langen; San Francisco, C. R. Weymouth, chairman, F. H. Varney, vice-chairman, C. T. Hutchinson, secretary, J. T. Whittlesey, H. T. Terwilliger; Atlanta, Earl F. Scott, chairman, Park A. Dallis, secretary, Oscar Elsas, Frank H. Neely, L. W. Robert, Jr.; Minnesota, W. H. Kavanaugh, chairman, E. J. Heinen, vice-chairman, F. W. Rose, secretary.

The Council voted to accept the $1000 bequest of the late Rear-Admiral Melville, with the understanding that the income be allowed to accumulate until it is sufficient to defray the cost of a die for the medal. This medal is to be awarded annually to such competing member of the Society as shall present the best original paper or thesis on any mechanical subject presented to the Society.

Jesse M. Smith was nominated to the Trustees of the United Engineering Society for election to The Engineering Foundation Board.

The establishment of a student branch at Virginia Polytechnic Institute was approved, and L. S. Randolph appointed Honorary Chairman.

It was voted that a meeting of the Society be held in San Francisco in September 1915 previous to the International Engineering Congress.

An invitation was extended to H. G. Stott to act as chairman of a committee to coöperate with the Standardization Committee of the Manufacturers' Association in the recommendation of flange standards for hydraulic work.

Calvin W. Rice, *Secretary.*

PROGRESS ON THE REPORT OF THE BOILER COMMITTEE

Those interested in steam boilers and the steam boiler industry, will welcome news of the rapid progress toward completion of the present revision of the proposed Boiler Code. As a result of the chaotic conditions now existing in this industry, due to the widely varying legislative restrictions and requirements in different localities, the interest taken in this important division of the Society's activities has been almost universal. The important part which this subject played at the Annual Meeting in December, was referred to in last month's Journal (January, page 41); the discussion occupied six separate sessions, aggregating twenty hours in all of continuous meeting, in which the proposed Code and the work of the Committee were discussed in detail.

Since the Annual Meeting, the Boiler Code Committee has been in session almost constantly, studying the criticism and suggestions offered in the Annual Meeting discussion, and has made what is perhaps the most thorough and painstaking revision of the Code that has been undertaken since the inception of the work. The work of revision has continued without interruption except for Sundays and holidays, for six weeks, including both day sessions and night sessions until midnight. This comprehensive and complete revision indicates how stupendous an undertaking the preparation of this Code has been. The number of important points involved in a matter such as this, and the number of interests directly or indirectly affected have been almost overwhelming to a committee endeavoring to produce a Code that should at once be complete, rational, technically correct and yet free from any ruling that might prove derogatory to the interest of anyone concerned in this industry.

This remarkable undertaking was inaugurated nearly four years ago, the Committee having been appointed on September 15, 1911 "to formulate standard specifications for the construction of steam boilers and other pressure vessels and for the care of same in service." The original instructions by the Council to the Committee were to formulate a model engineers' and firemen's license law, a model boiler inspection law and a standard code of boiler rules. Due consideration was given to the necessity of constructing and installing steam vessels and their appurtenances in as nearly perfect a manner as possible, the importance of preventing carelessness in their operation and the wisdom of having them inspected at intervals by disinterested experts. The importance of the problem was emphasized by the fact that there occur in the United States every year on the average between 1300 and 1400 serious boiler accidents, of which 300 to 400 are violent explosions; these accidents kill between 400 and 500 persons, injure 700 to 800 more, and destroy more than a half a million dollars worth of property.

In the appointment of the Committee which was made during the presidency of Col. E. D. Meier, seven members were selected as follows: A consulting engineer, former member of the Massachusetts Board of Boiler Rules; two professors of engineering; two boiler manufacturers; and an insurance engineer. The Committee began work immediately, the members proposing such an arrangement of rules as their individual experience suggested. It was early decided to use as a basis for the new code, the rules that had for several years been in operation in the States of Massachusetts and Ohio and which were acknowledged to be the best set of rules then in existence. Numerous meetings of the Committee were held during which these rules were deliberated upon and then modified or added to in accordance with the best information obtainable and the Committee's best judgment.

A first preliminary draft of the rules for construction was then prepared, and was sent confidentially to professors of engineering in technical schools, superintendents of inspection departments of insurance

companies, chief inspectors in charge of United States, state and municipal boiler inspection departments, prominent engineers known to be interested in the construction and operation of steam boilers, prominent manufacturers of steam boilers, and editors of prominent engineering journals. A letter was sent with each copy requesting the recipient to read carefully the preliminary report and then to give the Committee the benefit of any criticisms or suggestions he had to offer. All replies were given careful consideration, and at the Spring Meeting of the Society held in St. Paul, on June 16th to 19th, 1914, it was decided to invite all interests affected to appear at public hearings to be held in the Engineering Society's Building in New York, beginning September 15th, 1914. These hearings were the means of bringing together representatives of the steel manufacturers, of the railways, of all classes of boiler manufacturers, also of the American Society for Testing Materials, of the Heating Ventilating Engineers, of the National Association of Stationary Engineers, and of other associations interested.

It is especially worthy of mention that at these hearings, an agreement was reached upon uniform specifications for boiler steel and other material; uniform specifications for boiler tubes; uniform rules for safety valves; uniform rules for fire tube boilers; uniform rules for water tube boilers; and uniform rules for steam and hot water heating boilers.

After the results of the September and October Hearings were thoroughly digested, the Code was entirely revised to incorporate such of the suggestions received as were applicable and another preliminary draft (the third printing) was brought out to facilitate further study of the subject by the Committee and other organizations with which it had been in conference at the Hearings. A very limited number of copies were printed, and distributed to the Committee members and the representative organizations only which had been in conference at the Hearings.

The result of the proofreading of this third printing was a number of modifications in the construction code and the decision to reprint the Code in the fourth printing with the proposed laws, the tables of joint efficiencies and the license application forms omitted. This edition, (the fourth printing) was called a Progress Report and was sent not only to the Committee members and representatives of the conferring organizations but also to every member of the Society, in time for examination and study prior to the Annual Meeting, December 1-4.

It was the result of this Progress Report, which was brought formally before the Annual Meeting for discussion that as reported in The Journal for January, the unusually extended discussion ensued, involving the six sessions from December 1-4, and at these meetings, a large amount of valuable constructive criticism was received on practically all details of the Code. The importance of this criticism, and the urgent interest of the boiler manufacturers who desire an immediate completion of the work, were the cause of a conference early in December, following the Annual Meeting, between members of the Boiler Code Committee and the boiler manufacturers' associations, at which it was decided that the purpose of the Code could best be served by, first, revising it immediately while the suggestions from the Annual Meeting were fresh in mind and, second, by submitting the details of the revision to representatives from all organizations and interests known to be affected by the introduction of the Code, as proposed. It was felt that the desired result could be more surely obtained by even closer coöperation than had been obtainable in the past, with such other organizations and interests, as they had been shown at the hearings and at the Annual Meeting, to have the detailed knowledge on the many important factors of the work which would be invaluable to the Committee in an advisory capacity.

The result was finally the appointment of an Advisory Committee of 18 members which should sit with the Committee in a final attempt to revise the Code into practical, workable form and thus permit of its presentation at the next meeting of the Society at Buffalo in June in such form that no serious criticism in any magnitude should be heard. This Advisory Committee which was selected to represent all the principal interests involved in the production of the Code includes the following members:

D. S. Jacobus, Advisory Engineer, Babcock & Wilcox Company, New York.
F. H. Clark, Gen. Supt. of Motive Power, Baltimore & Ohio R. R.
H. H. Vaughan, Assistant to Vice President, Canadian Pacific Ry., Montreal, Canada.
A. L. Humphrey, Vice President and General Manager, Westinghouse Air Brake Co., Wilmerding, Pa.
Karl Ferrari, Erie City Iron Works, Erie, Pa.
H. G. Stott, Supt. of Motive Power, Interborough Rapid Transit Co., New York.
I. E. Moultrop, Asst. Supt. Construction Bureau, Edison Elec. Ill. Co. of Boston.
W. F. MacGregor, Supt. of Experimental Dept., J. I. Case Threshing Machine Co., Racine, Wis.
Richard D. Reed, H. B. Smith & Co., Westfield, Mass.
M. F. Moore, Assistant to President, Kewanee Boiler Co., Kewanee, Ill.
S. F. Jeter, Supervising Inspector, Hartford Steam Boiler Inspection & Insurance Co.
Thos. E. Durban, Gen. Mgr., Erie City Iron Wks., Erie, Pa.
F. W. Dean, Cons. Engr., Boston, Mass.
Wm. F. Kiesel, Asst. Mech. Engr., Penna. R. R.
Arthur M. Greene, Jr., Professor of Mechanical Engineering, Rensselaer Polytechnic Inst., Troy, N. Y.
Charles E. Gorton, Gorton & Lidgerwood Co., New York.
Elbert C. Fisher, V. P. & Gen. Mgr. Wickes Boiler Co., Saginaw, Mich.
C. W. Obert, Assoc. Editor, Am. Soc. M.E., and Secretary to the Boiler Code Committee.

The work of revision was begun on December 15, 1914 and has continued without interruption since that time. It has involved numerous conferences with

organizations and interests in order to settle satisfactorily the few remaining questionable features. It is also worthy of note, that the attendance by the members of the committee has been unusually large in view of the protracted period over which this work has extended (over six weeks continuously).

The work of revision is now rapidly approaching completion, and it will soon be possible for their report to be presented to the Council. If the report meets with the approval of the Council, it will be printed at an early date.

E. D. LEAVITT MADE AN HONORARY MEMBER

Erasmus Darwin Leavitt of Cambridge, Mass., was elected an Honorary Member of the Society at the meeting of the Council on January 12, 1915, in accordance with the vote of the membership by letter ballot.

Mr. Leavitt, who was the second President of the Society and served it during one of the most difficult periods of its early career, was born in Lowell, Mass., October 27, 1836. He was assistant engineer in the United States Navy from 1861 to 1867, and was consulting engineer for the Calumet & Hecla Mining Company from 1874 to 1904. He has also acted as consulting engineer for the cities of Boston and Louisville, Ky., and for Henry R. Worthington and others.

Mr. Leavitt is a member of the American Institute of Mining Engineers, the Boston Society of Civil Engineers, the American Society of Naval Engineers, the British Association for the Advancement of Science, the Franklin Institute, the Institution of Civil Engineers and the Institution of Mechanical Engineers of Great Britain, and is a Fellow of the American Academy of Arts and Sciences. He was awarded the degree of Doctor of Engineering by Stevens Institute of Technology in 1884.

DR. BRASHEAR PARTICIPATES IN THE TRANS-CONTINENTAL TELEPHONE TEST

Dr. John A. Brashear, President of the Society, on special invitation of Dr. Alexander Graham Bell and of John J. Carty, chief engineer of the American Bell Telephone Company, participated in a private test of the trans-continental telephone line from New York to San Francisco on Sunday afternoon, January 24, preparatory to the great gathering held the following day, the events of which are now common knowledge. The lines were connected up with Boston, Jekyl Island and San Francisco, covering a distance of 5000 miles, over which the listeners could plainly hear Dr. Bell in New York talking with Thomas A. Watson in San Francisco. It was Mr. Watson who listened to Mr. Bell in the first message sent over the original telephone.

Dr. Brashear says: "I regard it as a red letter day in my life, although during the past fifty years I have been so intimately associated with the development of science, particularly in the domain of electricity and astronomy and correlated sciences. Wonders will never cease, but this seems to be the climax of great things in electric communication for this century."

THE MELVILLE MEDAL

Admiral George W. Melville, Past-President and Honorary Member of the Society, who died in March 1912, left in his will a bequest of $1000, the income to be expended upon a gold medal and awarded annually for the best original paper or thesis submitted in competition. It has been decided by the Council that it will be necessary to allow the interest to accumulate for the purchase of a die for the medal before its award is instituted.

APPLICATIONS FOR MEMBERSHIP

Members are requested to scrutinize with the utmost care the following list of candidates who have filed applications for membership in the Society. These are sub-divided according to the grades for which their age would qualify them and not with regard to professional qualifications, i.e., the age of those under the first heading would place them under either Member, Associate or Associate-Member, those in the next class under Associate-Member or Junior, while those in the third class are qualified for Junior grade only. The Membership Committee, and in turn the Council, urge the members to assume their share of the responsibility of receiving these candidates into the Membership by advising the Secretary promptly of any one whose eligibility for membership is in any way questioned. All correspondence in regard to such matters is strictly confidential and is solely for the good of the Society, which it is the duty of every member to promote. These candidates will be balloted upon by the Council unless objection is received before March 10, 1915.

NEW APPLICATIONS

FOR CONSIDERATION AS MEMBER, ASSOCIATE OR ASSOCIATE-MEMBER

Cooper, Elisha H., Treas., Fafnir Bearing Co., New Britain, Conn.

Dinwiddie, William W., Experimenter, Edison Laboratory, West Orange, N. J.

Farmer, Frank M., Ch. Engr., Electrical Testing Laboratories, New York.

Fleckenstein, Harry, with Hindley Gear Co., Philadelphia, Pa.

Gulick, Henry, Pres., Gulick-Henderson Co., New York.

Hayward, Harrison W., Assoc. Prof. Applied Mechs., Mass. Inst. Technology, Boston, Mass.

Hemmerly, William D., Installation of Scientific Management, The Acme Wire Co., Oven Equipment & Mfg. Co., and Sentinel Mfg. Co., New Haven, Conn.

Lang, William H., Secy. and Treas., Phillips, Lang & Co., Inc., Chicago, Ill.

Mitchell, John R., Representative, W. H. Miner, Chicago, Ill.

Miyakawa, Kunimoto, Engr. Captain, I. J. N., Admiralty, Tokio, Japan.

Munn, D. Walter, Lecturer, School of Mining, Queen's Univ., Kingston, Ont., Canada.

Nichols, George B., Ch. Engr., Dept. of Architecture, Albany, N. Y.

Nolan, Quinces R., Supt. of Constr. and Surveys, Park A. Dallis Co., Atlanta, Ga.

North, Herbert B., Supt., Sentinel Mfg. Co., New Haven, Conn.

Nottingham, Avon R., Prof. Mech. Engrg., Purdue Univ., Lafayette, Ind.

Pearson, Robert H., Cons. Engr., Globe Indemnity Co., New York.

Piek, Stefaan, Genl. Mgr., Niagara, Lockport & Ontario Pwr. Co., Buffalo, N. Y.

Prussing, Rudolph E., Engr., Whiting Foundry Equipment Co., Harvey, Ill.

Skinner, Orville C., Supt. of Manuf., Standard Steel Wks. Co., Burnham, Pa.

Stimmel, Fred C., with The Casey-Hedges Co., Chattanooga, Tenn.

Thompson, John T., Ordnance Engr., New York.

Thurlow, Oscar G., Designing Engr., Alabama Pwr. Co., Birmingham, Ala.

Warfield, William G., Supt., Marion Pwr. Sta., Public Service Elec. Co., Jersey City, N. J.

Warr, William, with Robins Conveying Belt Co., New York.

Wright, George S., Mech. Draftsman and Mch. Designer, Sefton Mfg. Co., Anderson, Ind.

FOR CONSIDERATION AS ASSOCIATE-MEMBER OR JUNIOR

Defppeler, John H., Supt., Goldschmidt-Thermit Co., Jersey City, N. J.

Hickstein, Ernest O., Mech. Engr., Wichita Natural Gas Co., Bartlesville, Okla.

Komow, Maximilian, Instr. Mech. Drawing and Mch. Design, Murray Hill Vocational School, New York.

Miller, T. Lee, Asst. to Pres., Toledo Rwys. & Light Co., Toledo, Ohio.

Rollow, James G., Combustion Engr., Southern California Edison Co., Long Beach, Cal.

Simpson, Ralph, Mch. Tool Designer, Potter & Johnston Mch. Co., Pawtucket, R. I.

Weaver, William G., Lecturer in Mech. Engrg., South African College, Cape Town, South Africa.

FOR CONSIDERATION AS JUNIOR

Boyd, Ernest M., Draftsman, Mathews Gravity Carrier Co., Ellwood City, Pa.

Brooke, William C., with N. S. Hill, Jr., and S. F. Ferguson, Cons. Engrs., New York.

Brown, Albert M., with Sullivan Mchy. Co., Chicago, Ill.

Coldwell, John S., with Alberger Pump & Condenser Co., Newburgh, N. Y.

Field-Frank, Crosby, Cons. Engr., New York.

Hazzard, William S., with Southern Adjustment Bureau, Atlanta, Ga.

Karr, Alfred D., with Tiffany & Co., Silver Wks., Newark, N. J.

Kessler, Raines, with The Terry Steam Turbine Co., Hartford, Conn.

Lockwood, William G., Asst. Ch. Engr., Pierce Phosphate Co., of the A. A. C. Co., Pierce, Fla.

Low, Frederick H., with the Ford Motor Co., Highland Park, Mich.

Montgomery, Graham L., Inspector of Constr., Brooklyn Edison Co., Brooklyn, N. Y.

Nevius, Walter I., Asst. to Steam Engr., Inland Steel Co., Indiana Harbor, Ind.

Pope, Samuel A., with William A. Pope, Chicago, Ill.

Pound, Joseph H., Instr. in Mech. Engrg., Rice Institute, Houston, Tex.

Prest, Harold M., with H. R. Worthington Hydraulic Wks., Harrison, N. J.

Rush, Earl S., Draftsman, Iola Portland Cement Co., Iola, Kan.

Wegener, Francis A., Asst. Master Mech., Welsbach Co., Gloucester, N. J.

Wolfner, Ira W., Asst. Treas., Natl. Cooperage & Woodenware Co., Peoria, Ill.

APPLICATIONS FOR CHANGE OF GRADING

PROMOTION FROM ASSOCIATE

Hill, Harold H., Mech. Engr. and Dist. Mgr., Erie City Iron Wks., Cleveland, Ohio.

PROMOTION FROM JUNIOR

Hebberd, Loren L., Mech. Engr., Vaughn, Meyer & Sweet, Cons. Engrs., Milwaukee, Wis.

Mudd, John P., Engrs. Dept., The Midvale Steel Co., Philadelphia, Pa.

Rupf, Ernest L., Genl. Mgr., Bayonne Bolt & Nut Co., Bayonne, N. J.

Sowden, Parkin T., Mgr. and Mech. Engr., Standard Silver Co., Ltd., Toronto, Canada.

Yates, Sheldon S., Prin. Asst. Engr., New Haven Trap Rock Co., North Branford, Conn.

SUMMARY

New Applications	50
Applications for change of grading:	
Promotion from Associate	1
Promotion from Junior	5
	56

PUBLIC SERVICE MEETING

THE feature of the Annual Meeting held in December was the Public Service meeting which required the entire day on Thursday, December 3, and some time on Friday morning. These sessions were arranged by the Public Relations Committee, who desired to draw to the attention of engineers the opportunities for the application of their special training and knowledge to the many important engineering problems that confront the large municipality. The papers and discussion showed the broadening field of work for the engineer and the need for a public-spirited service in civic affairs. There were nine papers presented, which are here published in abstracted form, together with a brief account of the discussion.

At the opening session of the Public Service meeting held on December 3 during the Annual Meeting, brief remarks were made, previous to the presentation of the professional papers, by the Hon. John Purroy Mitchel, Mayor of the City of New York, by Andrew Carnegie, Honorary Member of the Society, and Dr. John A. Brashear, President-elect.

President Hartness who presided said, in introducing the Mayor, that in other days the engineer was needed in the administration of cities; but the modern city has grown to be a piece of mechanism—the more modern the city, the more complicated the mechanism. The highest type of modern city is the great city of New York and the Society was honored in having its Mayor as a guest.

Mayor Mitchel said in the course of his remarks that while at the present time nearly every one of the great constructive activities of the city was in the hands of engineers, yet there is still great need of assistance in working out the problems of administration, public and civil service, accounting, and all the multiplex activities of a city government represented by its administration departments.

Mr. Carnegie eulogized the work of American engineers and commended the Mayor in his aims in solving the difficult problems presented in city government, concluding with a few facetious remarks at the expense of Dr. Brashear, his intimate friend. Dr. Brashear replied in kind, speaking also of the valuable assistance Mr. Carnegie had rendered in an important research which he had just completed and of the pride taken by the people of Pittsburgh in the great educational and scientific institutions made possible by Mr. Carnegie.

THE FUTURE OF THE POLICE ARM FROM AN ENGINEERING STANDPOINT

BY HENRY BRUÈRE,[1] NEW YORK

Non-Member

The author states as his reason for a discussion of the problems of police administration at a meeting of mechanical engineers that the most neglected field of public service in America is the police department. There is no part of municipal administration, not itself in the engineering category, that more urgently needs the aid of engineering method than does the "police arm." He makes this assertion on two assumptions, with which, he says, there may not be general agreement. The first assumption is expressed in a definition of the substance of the "engineering method." The second assumption is expressed in a definition of the functions of the police arm. These definitions are as follows:

a The engineering method consists of applying scientifically determined knowledge to the execution of a particular problem, and the use of ordered and analyzed facts as a basis for formulating conclusions in respect of that problem. As a result of the repeated application of the engineering method to like or similar problems a technique is established for achieving a particular object repeatedly, with least waste of energy and resource

b The function of the police arm of government is to ascertain all the facts regarding the phenomena of crime and disorder, and by the use of those facts as a basis for action, direct and collateral, to minimize and extirpate crime and disorder

In respect to the functions of the police arm the author says that generally, until now, the functions of the police have been assumed to be something as follows:

a General enforcement of certain laws and ordinances

b Enforcement of certain other laws and ordinances selectively, according to the feasibility of their enforcement and the state of public opinion regarding them

c Enforcement of certain other laws and ordinances on complaint of persons injured by their infraction, with particular respect to the perpetrators of the injury

d Repression or prevention of crime and disorder, by the process of tacit intimidation; in other words, the brass buttons and swinging night stick

e Physical and militaristic suppression of express disorder, such as riots and street brawls

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Abstract of paper and discussion presented at the Annual Meeting, December 1914. Complete paper may be obtained without discussion, price 5 cents to members; 10 cents to non-members.

f Investigation of crime committed for the purpose of tracing, identifying and apprehending the criminal

g Performance of inspections, regulation of traffic, rendering aid to citizens, and miscellaneous other incidental functions that are committed to the police as matters of convenience, and are not generic to the police problem

The one common ideal of police service that has been developed in American cities is that the police must be physically well-conditioned and personally honest. This is about as far as any American city has gone, with the possible exception of Toledo, under the rule of Brand Whitlock, and New York City today under the administration of Mr. Mitchel and Mr. Woods.

In the minds of the conventional police, criminals divide themselves into four groups:

a Aliens, enemies of society violating the rights, safety and peace of a community, "to be put away," thus gotten rid of

b Native incorrigibles, endowed with natural perversity, namely, the familiar thug, the gangster, the crook

c Fortuitous criminals who become subject to police action because of moral lapse or temporary aberration

or as belonging to

d A miscellaneous group including special and individual cases too numerous to catalogue, but comprehended generally in 174 items of the standard crime classification, as used, for example by the New York police

There has been no recognition of crimes as the consequence of remediable social conditions or the effect of individual abnormalities, either physical or mental, resulting from removable causes.

There should, however, be a statistical basis for police work, as there is a statistical basis for engineering work. There is nowhere in the world a collection of social data so potentially useful to the development of a community as lie in every great municipal police department, in the records of arrests, in the records of crime disposition, in the investigation of crimes, in the notebooks of policemen and in the memoranda and reports of detectives.

In the report of the New York police department for 1913, the only reference to these records is found in a single sentence under the heading Bureau of Records:

> During the year 1913 there were received and filed in the Bureau of Records a total of 35,013 documents.

New York City employs 11,000 policemen who made 119,736 arrests in 1913. It has a detective bureau of 150 detectives who investigate 55,000 cases of crime a year, but it has not a single employe engaged on an analysis of the facts brought into the archives of the department in the form of reports on investigations and records of arrests. Commissioner Woods is the first police commissioner in America, so far as the author knew, who has thought it worth while to put in his budget a request for statisticians. Next year he will have a statistician under the supervision of a deputy trained in statistical analysis, who will study current police conditions and police work. Not only is he taking this step, but he is utilizing every member of the force as an agent for gathering social facts respecting such matters as unemployment, destitution, improper guardianship, upon which intelligent police work must be predicated.

While it is generally known that economic distress and unemployment lead to an increase of small crimes against property and the breakdown of natural self-control, no American police department has ever analyzed its records to correlate degrees of unemployment with perpetration of crime, and thus furnish the basis for police activity with regard to unemployment. New York City, however, has had this matter forced upon its attention. Conditions of unemployment last year furnished the opportunity for anarchistic agitation, demonstrations of violence, invasions of churches and other disorderly practises, on the avowed theory that only in this way could the public be brought to realize the crucial importance of unemployment conditions.

These violent manifestations of disorder, which had their relation to conditions of unemployment occurring in 1914, make it seem a natural function of the police to ascertain the facts regarding conditions of unemployment in 1915. The police department is the logical agency to call the attention of the community and other branches of the government to the need for taking some constructive steps to mitigate abnormal unemployment.

In New York, one of the principal problems confronting the police is control of traffic. It was never conceived by the builders of modern cities that thoroughfares, intended for residential purposes and often crowded with children, would be utilized by high powered motor trucks and automobiles, and that many streets designed for local traffic would become the thoroughfares of a vast population. As a result of this condition there are killed each year in the streets 445 persons.

It is peculiarly the function of the police department to work out means of preventing this appalling condition, because the police department is charged with responsibility for regulating traffic. Up to January 1st of this year, New York City's police did not record information necessary for an intelligent analysis of the conditions surrounding the death of persons in the streets, although they are required to report the facts regarding each occurrence as a part of the coroner's investigation.

By focusing the attention of police captains and patrolmen on the incongruity of using congested traffic

streets for play spaces for children, the present police commissioner obtained from patrolmen and their officers suggestions concerning the use of vacant lots for play purposes and for closing to traffic during certain hours of the day streets used by children for play. The mere fact that the police themselves formulate such suggestions and assist in putting them into effect, brings about a psychological change in the attitude of the policeman to his community relationships which is full of the greatest possibilities for the development of police service. It is merely another illustration of applying the scientific or engineering method to a particular problem, instead of continuing along from year to year, from generation to generation with fatalistic resignation to whatever may happen.

The author anticipates possible criticism of his suggestions that they overlook the necessity for dealing with criminals as criminals and maintaining law and order by vigorous police action. It is no part of this suggestion that law enforcement be relaxed. A sentimental attitude towards breakers of the law and violators of the public peace and social rights of the community is not advocated. On the contrary, a very drastic action is favored regarding them where such action does not defeat its own purpose. It is recognized that the existing product of social environment, of disease, of mental degeneracy, of moral perversity, cannot be dealt with through eliminating conditions which breed them, but have to be dealt with through our penal machinery, and will probably sooner or later, for the protection of society, become the subject of police action.

A very considerable part of present criminality can be eliminated by intelligent preventive action. This preventive action should be initiated, if not actually taken by the police. To initiate it intelligently, the police must act not on general information or impressions, but on carefully gathered data. These data will not in every instance point to clear conclusions or be capable of definite analysis. The work of correlating crime to social conditions is practically untried. If law and order lie at the basis of industry, if social adjustments are essential to economic welfare and civic development, then no section of the community can ignore the police problem. It is particularly important that engineers who are the expert advisers of our industrial and economic life should make their special experience available to police administrators in formulating a method for arriving at the facts underlying the police problem.

The latter part of the paper deals with police organization. Involved in this are questions of training of officers; selection of officers; ratings for efficiency and selection for promotion; enforcement of discipline; methods of compensation; welfare activities, including educational work, medical supervision and provision for insurance and pensions. These various questions are discussed briefly. The author says further:

The outstanding fact regarding conventional police organization is that it is military, and the outstanding fact regarding military organization is that it is not intended to accommodate itself to shifting social development, to relate itself intimately to community life, to be sympathetic and understanding, or to be flexible. Military organization deals with individuals as subservient members of a group and not as self-governing factors coöperating in the execution of an undertaking. In police departments it has aimed at the one consideration everywhere recognized as fundamental in police work, namely, personal integrity. The military assumption of moral and mental dependence of subordinates on superior officers, has, however, been one of the great weakening forces of police work. In the case of policemen, personal integrity results from exercise of self-restraint in inhibiting an impulse to accept a bribe, to connive at a violation of the law, or to practice extortion. The faculties needed to resist temptations of this character must be developed through a process of self-reliance, through a formulated, even though rudimentary, philosophy of personal conduct. The soldier ceases to be responsible for his moral conduct once he places himself under the command of a superior officer. This condition, while of course less marked in police service than in a purely military organization, still prevails to a certain degree, and has been a conspicuous embarrassment to the development of individual police initiative in larger American police departments. Mr. Woods, New York's present police commissioner, has no military training or sympathies, and is dealing with the officers and men of his department on the assumption that they are self-controlling and self-initiating centers of police thought and police work. This method is a promising contrast to the policy of the martinet, or a policy of easy tolerance, that customarily prevails in police work, and stands out against the old conditions as strikingly as the modern, enlightened employer's policy in industrial management does against the old time shop boss method of dealing with workmen.

The future development of the police arm, if police work is to be constructive and to fulfill its possibilities, must be along the lines of the engineering method. The police department through its multitude of agents is the best equipped of all social agencies for apprehending sympathetically and certainly those adverse social conditions in the community which can be remedied only through community attention. The police department should be the eyes, ears and feeling fingers of the city government. If it finds through its investigation and observation that recreation facilities are inadequate, that this bears upon crime conditions and the welfare of the city's youth, those facts should be driven home to the educational and recreative departments, and in the same way with other conditions.

The police department of a great city should be the nerve center of the city's government, capable of acting with vigor when a situation demands vigorous treatment, strong to protect the safety of the public against disorder and the unruly, informed on conditions which manufacture crime and criminals, in order that these conditions may be remedied where remedies are possible; aggressive instead of defensive, courageous instead of fatalistic, organized for achievement instead of for mere opportunism, militant but not military, except in the sense of obedience to necessary rules and responsive to discipline; free to deal honestly with conditions in the light of those conditions instead of in the light of statutes written by dead hands; coöperating intelligently with charities, corrections, health, hospitals, and educational departments.

To bring these things about the police problem must be broken up into its proper functional divisions. Crime when perpetrated by professional criminals must be dealt with differently from crime committed by those who stray temporarily from the paths of rectitude. There should be organized a national service for the detection of criminals and crime prevention along the lines of similar service now engaged upon forestalling and detecting counterfeiters. The voice of the police department must be heard in the courts when punishment is meted out to criminals, not because it is the police department, but because it is informed and expert on questions of penology.

Above everything else back of police work there must be developed a scientific spirit, the true engineering spirit; in place of cunning and cudgels there must be substituted a policy based upon a knowledge of needs, standards of service feasible of attainment and organization devices to accomplish them, methods of administration and the plant to facilitate their accomplishment, and the genius to capitalize the initiative and individuality of every man on the force.

DISCUSSION

R. P. Bolton congratulated the author on the discovery that there is a purpose in engineering methods and that there is also the possibility of advantage to one department of city government in the utilization of engineering methods.

The rights of a citizen extend to the exercise of police powers on the part of any individual, and the police are no more than paid delegates of citizens performing this duty for them. The question as to whether these men should be regarded from a militaristic or departmental view has more than one side, the advantage of military organization consisting in the addition of *èsprit de corps* to the moral character of the police officer, while the provision of weapons is of dubious value, and certainly tends toward suggestive imitation on the part of other persons.

The author's suggestion that the police should be charged with the study and dissection of the causes of crime would lead to doubtful results, since the work is in itself a function of scientific investigation, and the local police would be confined to the study of local causes, which might be misleading. The proposal would only result in additional jobs in scientific bureaus added to the police department, and publicity given to such statistics and information might have an unfortunate result in suggestive inducements to crime.

Some at least of the accidental deaths in the public streets are due to the neglect on the part of our Department of Public Works to provide proper isles of safety, in view of the crowded conditions of traffic.

The author spoke of the prevention of crime by the provision of ample street lighting, but has himself taken a personal part in the recent reduction of city lighting, in the interests of a parsimonious economy.

He believed the difficulties experienced in upbuilding the character and in extending the usefulness of the police force are attributable to causes entirely different from those advanced by the author. He had found a feeling prevailing among the men that they are denied a recognition of loyal service on the part of their superiors and of the public, and are subjected continuously to unfair treatment by politicians and by the newspapers, and also that the magistrates almost unanimously seemed to regard a police officer as either a liar or a scoundrel.

He agreed with the author as to police pensions, but pointed out that this condition is applicable to all classes of city employes. The essential error in this system lies in the provision of pensions paid to idle men still capable of work. The process should be entirely changed, so that increasing age should be met by a proportionate reduction of labor and not by payment for idleness, and the value should be recognized of the continued service of experienced and faithful employes long after their full physical capacities could be exercised.

The application of engineering methods to the problems of the police would include the recognition, prior to the question of efficiency, of the value of loyalty, of merit and long service, and also the establishment of a system of fair treatment of the members of the force.

Clement J. Driscoll[1] in a written discussion said that the cause for police inefficiency in New York can be found in the fact that in 13 years the department has had 10 police commissioners. Not one of these doubted the efficiency of the engineering methods and not one did not fully realize before he retired, or was forced to retire, from the department that the police problem was such that only careful, patient application of scientific methods would solve it. All of them would say to the engineers gathered here that all the methods known to science would be of little value while the control of the department was in the hands of the political powers of a community. The Panama Canal, one of the supreme engineering feats, was made possible only because the engineer in charge remained on the job long enough to work out the engineering problem. But even Mr. Goethals would not have mastered the police problem of New York by the application of the engineering method if he had been subjected to the conditions under which all the administrative heads have had to work. No matter how determined a police commissioner may be to keep his department free from politics, it will be subjected

[1] Bureau of Municipal Research, New York City.

to political influence so long as he himself is subject to arbitrary removal and the mayor of a city is held responsible for a police department and its management.

In summarizing, he urged as the first step toward increasing the efficiency of the police, the adoption of statutes providing for a more permanent tenure of office for the administrative head; second, the complete separation of the police department from the mayor's office, placing the full responsibility for the administration and conduct with the police commissioner or administrative head, regardless of his title; third, the application of the engineering method; and, fourth, the complete abolition of the system now in vogue throughout the country of adopting policies of law enforcement which will result in the enforcement of the statutes as written.

Alex. C. Humphreys said that his chief reason for speaking was to pay a tribute to Mr. Bruère, and to say that he was sorry that the discussion could not have been more appreciative of Mr. Bruère's courtesy. He said there was no fundamental inconsistency between Mr. Bruère's paper and Mr. Driscoll's discussion, though some other inconsistencies are apparent in connection with the discussion. He suggested to the New York citizens present that they had better not take upon themselves the task of being their own policemen; they might get into trouble. They can, however, advise and they can educate the public as Mr. Bruère ha l advised, and here he differed from the last speaker. He saw no reason why Mr. Bruère's suggestion with regard to a bureau cannot be carried out. The direction would have to be in the hands of a man qualified for scientific investigation. Under such direction of such a man the facts could be gleaned from the rank and file of the force. This would involve no inconsistency but might be a tremendous agency for the education of the public; and if the public could be sufficiently educated, the politics of the situation would be taken care of. The speaker said that he agreed absolutely that the present troubles in connection with police control are largely due to the interference of politicians.

The Author disagreed with Mr. Driscoll in saying that the greatest difficulty in this matter is politics. There is no politics in the police department for political reasons. The reason is that the police department does not know what the gang problem is. The thing that is most needed is not the elimination of politics, but more of the kind of politics that men such as the engineers present would uphold.

In answer to Mr. Bolton, he did not recall having suggested that a new bureau be established. He suggested that there be given to the police department the facts regarding outside conditions, not gathered by impressions, but based upon the actual experience of the department. There is no problem which Mr. Bolton has ever been called on to face that he does not or should not reach in the same way. And in engineering questions, the question of lighting public streets, in which he has an interest, cannot be solved by a general assumption that a lot of light is going to reduce crime. On this theory one can get ten times too many lights. Lighting under such circumstances may not reduce crime at all, but simply add to the payments made by the city to the lighting company. In settling the questions of lights and of gangs, the police department has to approach the problem just as any engineering question must be approached. If gangs exist because they have the protection of politicians, that cause ought to be ascertained.

His plea was that we proceed with regard to this whole question on the basis of facts, not on that of passion or sentiment, or of politics, or of impulse or judgment. He asked engineers not to find a way of putting on the shoulders of others the responsibility for existing conditions, but to take it on their own shoulders. To have, as some one suggested, a police commissioner continuously on the job would not mean success in police administration. He could not understand his problem merely by continuity of service, but would have to employ the engineering method advocated by the author.

He hoped that as a result of this conference some thought would be given in each community represented to getting a fact basis for police administration, so that in dealing with this most easily complicated division of city government we shall not have to act merely upon passion, impulse or newspaper headlines.

SOME FACTORS IN MUNICIPAL ENGINEERING

By Morris Llewellyn Cooke,

Philadelphia, Pa.

Member of the Society

The author calls attention to the wide opportunity for the activity of engineers in municipal work and to the fact that at the present time a large part of this field is either not covered at all or covered by non-technical men. The author emphasizes, however, the necessity for the cultivation on the part of the profession of a broader and more collective interest in public affairs. In this he follows up the theme advanced in a paper read some years ago before our Society under the title "The Engineer and the Public." There is a note of warning that with the growing consolidation of manufacturing and other enterprises, especially in the utility field, there is danger that the cities of the country will be left without proper engineering advice in certain of their engineering questions. The author points out that the matter of viewpoint and a genuine public interest are as essential in the engineer who is to advise a city as ability and experience.

An important part of the paper is the author's reference to the function of advertising, both as affecting the professional activities of the engineer and in the movement to educate the public to the necessity for having public work done on an engineering basis. He holds that certain kinds of municipal engineering, street cleaning for instance, are based on a growing appreciation on the part of the public of the factors of the problem and that this

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can only be developed through systematic and aggressive advertising methods.

The effectiveness of the engineer in public employ is very largely dependent upon the support given to him by his profession in the education of the public to proper policies of administration. The engineer holding a public position is not " in politics " and to be a success must have the collective support and advice of his profession. There are too many matters that should be determined by technical and scientific considerations now decided by vote. Attention is called for instance to the archaic systems of appropriation and control of the budget now in general use in our municipalities with suggestions for remedies.

Civil service as it applies to filling the higher technical positions is referred to and a note of warning sounded as to the growing complexity of all governmental problems. Lines along which municipal agencies may be simplified are indicated, and a suggestion is made for a municipal reference library as a branch of the Engineering Societies' library.

Quotations follow from different sections of the paper:

The test by which the role of the engineer is to be determined will be the development in our profession of a genuine spirit of public service. The community is apparently ready to accord the engineer a leading, perhaps a controlling part, if the engineer will consider that in every decision and act there shall be the clearest possible recognition of the public interest. We should remember that democracy can use the engineer without giving him either a leading or a controlling hand in affairs. This use of engineers has been conclusively demonstrated by public utilities companies, especially during the last thirty years. In most of our larger cities during this period there have been operating one or more so-called "big business" men who have built large fortunes and a certain kind of fame in the development of enterprises in which engineering was an important factor and in which it should have been the paramount and controlling factor. In these enterprises engineers have necessarily been used, but not in a leading or controlling capacity.

It would probably require considerable research to get the names of the engineers used by Charles Yerkes in Chicago; by Martin Maloney in Philadelphia; by Anthony N. Brady in New York; and by Patrick Calhoun in San Francisco. As a profession we may as well face this problem and decide whether in the further upbuilding of our cities, we are so to serve democracy as to be warranted in demanding and to be entitled to receive a position comparable to the real importance of our work.

That profession which considers only its own and its clients' interests without a proper regard for those of the general public will be accorded the same position which history has always given those who are led by no higher star than self interest, however enlightened that self interest may be. I firmly believe that the engineering profession is rising to meet its broader responsibilities with perhaps an even more quickened pace than that which during recent years has wrought such sweeping changes in the medical profession and that of architecture. There are certain kinds of engineering in which financial and almost all other kinds of preferment depend on an attitude of mind which, while not necessarily anti-social does not provide sufficient opportunity for entertaining a virile public point of view.

As a representative of public, rather than private interest, it is my duty in choosing the advisers of the city, which I have the honor of serving, to satisfy myself not only as to the ability of those we employ, but also as to their disinterested—yes, their public point of view.

No matter how able a man may be, how broad his experience nor how high his standing, his service to those who employ him must at all times be consistent with the public interest if, from my point of view, he is to be available for public employment.

Judged by this standard, there are in certain fields of engineering almost no engineers who are at present available for the service of the public and who at the same time have had sufficient experience for large undertakings. In the past few years we have had unusual opportunities for seeing at close range the professional attitude of those equipped with the technical knowledge required in advisers to cities on utility matters. It has been practically impossible to secure the services of those with reputations already made in the electrical field. Some of our experiences could be considered on the whole rather amusing were it not for the fact that we are left under the obvious conclusion that for the average city official to get good advice on these matters, is well nigh impossible. What is more objectionable is that this condition is one quite generally recognized as true by city officials.

I must be careful to emphasize the fact that no criticism of any individual is embraced in these remarks and that I am simply pointing out a danger almost necessarily confronting the engineering of an industry dominated by financiers having no knowledge and little appreciation of such professional standards as engineers are supposed to have.

The same tendency is to be noted in other branches of our profession. An eminent authority on concrete, who is in intimate touch with the men who are practising in this line, was recently asked for the name of an engineer who was not in anyway affiliated with the large manufacturers of this material and after considerable study was able to think of only one man. There is nothing necessarily improper in this situation,—it may simply mean that all the competent men in this line receive retainers from manufacturers. Some months ago I wanted to retain an engineer fully posted on the details of a certain sub-division of railroad operation. It was extremely difficult to find a man without recognized affiliations which would preclude his retention. Again I am informed that there are no asphalt experts who do not receive retainers from the manufacturers. It is a condition which should be provocative of thought by engineers.

Public employers up to the present have been almost a negligible factor in furnishing opportunity for employment or for the making of a reputation. It is perfectly natural, and it is in accord with former ideals that engineers should feel their first duty to be to these private employers. But in this time of broader and deeper social consciousness, it seems to me that this standard must change.

The point I wish to make is that engineering has now reached the stage of development where it has become a profession in the highest sense of the word. The engineer

being a scientist, his responsibility should be for the development of facts, regardless of whose advantage they may serve. I have in mind that the service of an engineer should be as the service of a judge, as opposed to the service of a lawyer who confessedly seeks out and represents the interests of his client, and often "makes the worse appear the better cause." This is justified by the fact that lawyers are not scientists, and by the assumption that there shall always be opposing counsel.

If this municipal field is to be one in which engineers of ability, sincerity of purpose and high ideals are to find a permanent and satisfactory outlet for their energies, our profession acting as a profession will be one of the main agencies bringing about certain fundamental changes in the attitude of the public. In the minds of too many engineers, participating collectively in matters pertaining to municipal engineering means "getting into politics." Architectural work being a part of the business of The Department of Public Works in Philadelphia, we have had the coöperation of the American Institute of Architects and of its Philadelphia chapter from the beginning. . . . We have had the constant, indefatigable and valuable support of the secretary of The American Society of Mechanical Engineers in our efforts to maintain the highest professional standards in the work of the department. But engineering bodies as such have given us no assistance and so far as I know have taken no part in the discussion of federal, state and municipal engineering, except in the matter of conservation which for some reason is considered as innocuous as a prayer meeting.

Many municipal engineers in this country are beginning to adopt the European system of employing non-residents for certain highly specialized positions. Whenever this is practised it excites criticism and abuse. As yet no technical organization, so far as I know, has recognized the opening thus made for technical merit and given moral support to the movement. Again I have tried to get support from organized engineers in the obviously necessary procedure of employing experts outside our regular staff, but without results.

The public must be taught that public service is not different from private service in that forward steps come frequently, even usually, as the result of a large amount of preliminary investigation. Again, the public, of which please remember we are a part, must be educated to place more responsibility on individuals, thus making it possible to do away with the great inefficiencies which inevitably accompany board and committee management. As long as we have boards and committees they will vote,—and they will insist on voting,—on matters that are not questions of personal opinion but questions of facts which ought to be determined by the facts. It is one of our duties as technical men to carry on a propaganda which will show to the public the difference between those problems of policy and public interest, that are properly settled by public opinion and those scientific problems which are improperly settled unless they are settled according to the facts. Mr. Frederick W. Taylor, Past-President of the Society, in recent lectures has very forcibly and lucidly suggested this fundamental difference. For instance, my opinion may be as good as that of any other citizen's as to how fast an automobile should be allowed to operate in different sections of a large city. The opinion of any member of this Society is as good as that of any other citizen as to the penalty which should be inflicted for false registration. On the other hand, the designs for a bridge; or the specifications for a sewer; or the plans for the laying out of a public park; or the organization of the police department; or the fighting of fires; or the elimination of mosquitoes are necessarily the work of experts. Such work will always be indifferently done if done by voting; whether the voting is by the people at large or by a committee or board acting for the people. Notwithstanding all the boards and commissions that are created in the generally approved laws of today, there should be no uncertainty as to what questions they may vote upon. It is therefore one of the duties of the educated to carry this message to the people and in doing so I do not think there will be any more powerful method than to give the great mass of the people a larger and larger knowledge of expert work.

I am not one of those who feel that all our short-comings are "the fault of the people." I would rather assume my share of the responsibility for conditions as they are and then join with my professional associates and the community at large in bettering them. If we engineers are to have any prominent part in this there are fundamental changes which we shall have to make in our own equipment for the work. In the first place, we have to get rid of the now old-fashioned idea that advertising is a crime. I admit that as a part of my work as a public official I put in a great deal of thought on what may be quite properly called advertising. By that I mean that I pay less attention in my reports to dignity of form and diction than to making them sufficiently interesting to be read. It is only as we engineers who are public officials learn to make the public, sometimes against its will, understand our work, that we are to get that degree of popular support for it which will make it possible for it to be done in an efficient manner.

In my opinion it is going to become more and more a necessity, not only in public but in private work, for engineers to be able to popularize what they are doing. It is true today that a man who wants to do really good and efficient work can do so only after an aroused public opinion. You cannot drive people in a democracy. So I admit that in offering employment to an engineer, other things being equal, I want what might be called a good advertiser. You can secure appropriations for work more easily when it is well advertised. The Panama Canal is a good example of this principle. Again, advertising is the best possible check against ill advised expenditures. In building our Byberry and Bensalem Service Test Roadway we erected sign-boards on each of the 26 sections giving to the layman the exact method of its construction in non-technical language. If the public knows how a street is supposed to be constructed or cleaned, you do not require as many paid inspectors on the job.

The development of some varieties of municipal engineering is absolutely dependent upon the development of public opinion and must proceed with it. The matter of street cleaning is largely a question of an improved public taste in the matter of street paving. Unless streets are well paved they cannot be well cleaned except at a prohibitive cost. To jump from one degree of cleanliness in this respect, to another, without a supporting public opinion, may be enough to wreck an administration and to set the

tide of civic improvement running in the opposite direction.

The newspaper is the great educator in these matters today. But we are already using in Philadelphia moving pictures, parades and exhibitions. The possibilities of these and other means of publicity are not yet fully understood.

Take, for instance, the movement which has led to the formation of large numbers of business men's associations and improvement associations. This affords one of the very best examples of the present vitality of American public life. Our leading men should accept them as something that has come to stay and coöperate with them in such a way as to direct their activities into profitable channels. It seems to me they afford the most promising agency through which in the first place, the thought of the public on civic questions can be crystallized and secondly through which that thought can be given expression in definite public procedure. I have found these associations ready and anxious to hear from men who had definite knowledge on matters of public interest. It should be the attitude of any engineer who wants to play his part in the community, to affiliate with one of these organizations and to help to make it an influence. You can rest assured that the man who is in public life for his own personal advancement is bending every energy to defile and degrade these institutions and to divert them from the high mission which they have it in their power to carry out, so they need our help.

In such a discussion as this, one cannot ignore the civil service. It is always a pleasure to say that personally I could not hold public office if it were not for the safeguards and reliefs that our Civil Service Act affords. At the same time without repeating what I have said in other public papers on the subject, I want to call attention to one fundamental misconception under which the entire civil service question in this country apparently rests. Civil service appears to be founded on the theory that the best man for the position will apply for it. I think it is the experience of every employer of men—and this is especially true in filling the higher positions—that the best man will not apply. On the contrary you will usually have to go out on the scriptural highways and hedges to find the best man and then having found him, fall on your knees and beg him to accept the positions offering such opportunities for public service and professional independence as are most likely to secure him.

This is the way to get good public servants. It is almost impossible to find men who have many of the qualifications for our work combined with a willingness to enter the public employ. Even if public employment should come to be considered more desirable than it is at the present moment, I think that this difficulty in finding the best man would still be encountered. Therefore, if we are to have the highest class of men in important engineering positions we must develop some merit system by which the appointing officer is given a greater opportunity than he now has of finding the man for the job. In this work it is impossible for our engineering societies to take an important part.

I believe, for instance, that if the secretaries of the four national engineering societies could be authorized by their several councils to associate themselves as a civil service board to act in an advisory capacity to federal, state and municipal civil service commissions, it would be a decided step in the right direction. Suppose the president of the Borough of Manhattan should want to secure a competent engineer to put in charge of the highway department. Through the New York City Civil Service Commission he would state the problem to this suggested advisory board which in turn would appoint say three engineers to act as his counselors in finding the man. The appointing officer would keep these counselors in touch with the search and when he was ready to make a choice, secure their approval before entering into a contract. In this way the merit system would act as a check against favoritism but would allow the appointing officer the widest possible opportunity to search for the best man available.

This procedure is a radical departure from the present idea of civil service, which is based on the assumption that it is impossible to allow the appointing officer to have anything to do with the selection of his men. Even under the most advanced forms of civil service the appointing officer is confined to a full statement of the qualifications he is trying to secure. One never exactly fills a position with just the kind of man in mind when the search started. It is a question of compromise and the appointing officer is the one who is in the best position to know where concessions can be made and which among the several requirements are the most indispensable. There would be no objection to a check on this action of the appointing officer through some kind of a written test. But to choose men for positions paying \$5,000 to \$25,000 a year on the results of a written examination is absolute folly. So far as I know engineers have never taken a hand in the discussion of methods under which engineers shall be chosen for positions in the public service and it seems to me high time they should do so.

Among other subjects in the paper not covered in the foregoing extracts is that of records of data upon investigations and work accomplished by municipalities. Not only are such records very meagre, but they are practically unavailable except to those who make them. As a practical suggestion, the author believes that a distinct contribution which the Engineering Societies could make to the solution of the question would be to establish in the library a section devoted to a Municipal Reference Library. At the present time there is no possible way for a city official to be sure that manuscript reports on engineering matters will be available twelve months after they are made. The author had, for instance, a digest on American street cleaning methods prepared by Day & Zimmerman, Consulting Engineers. It is an exceptionally valuable document. He knew where it was today but there was no possible machinery provided in Philadelphia or in any other city whereby officials could be sure that they could find such a report a few months after its preparation. This manuscript would be of very great value to any city official charged with the problem of extensive street cleaning. He would be glad to deposit this report in any library properly organized to receive it.

The same is true of literally dozens of reports on gas, lighting, electricity, garbage disposal, city plan-

ning, police discipline and others prepared under the present administration in Philadelphia. He knew that, if this suggestion was adopted and such a library was started, city officials all over the country would be glad to have extra copies made of every report which should properly belong to such a library.

DISCUSSION

Alex. C. Humphreys said that while he was in sympathy with much of that presented by Mr. Cooke, he differed from him strongly as to details and in so doing he was guided by a wide experience with engineers and municipal governments.

He believed there was not the slightest difficulty in getting the right kind of engineers for the work referred to, if they were properly approached and fairly treated. If, on the other hand, one approached these men with the idea that because they have been in a certain line of work, they must necessarily be biased in their opinions, one should not expect to get the best results.

The speaker was unable to understand why it should be recommended that a library on municipal engineering should be set apart from the rest of the library. If this should be done for municipal engineering, why not for all other branches of engineering. Then, where should the lines of division be drawn. He was reminded of the advice he had given some time ago regarding a certain book on the finances of public utilities. This book was misleading in the hands of the uninformed by reason of its plausibility. The advice given to those directly concerned was to purchase the book and so be prepared to controvert its false teachings, particularly as this could be done through its own inconsistencies and contradictions.

As to the absence of standards, the speaker thought that the trouble in large measure was that sufficient attention is not given to the fact that working standards can be established only by taking all factors into account; the scientific, upon which there is so much stress laid, and also the practical factors, including the necessary limitations of application,—the commercial, the financial, and the human.

If standards are being developed for the guidance of others, such work must be done cautiously and with a keen appreciation of the responsibilities assumed. Enthusiasm alone is not only not sufficient but may be most dangerous. Those who undertake this work must first of all be competent to do it, and then must secure the faith of those in control with regard to their integrity. The speaker was emphatic in saying that he resented the pervading tone of the paper, which seemed to imply that because an engineer has been in the service of public utilities he is not to be relied upon to give honest advice in connection with public affairs. He did not believe this to be true of the great majority of the engineers of the United States. He believed that those who made such an accusation were unworthy of a place in the profession.

E. H. Merriam said that every engineer engaged in public work should have in him some element of the salesman with a keen appreciation of the need of educating the public to the necessity and importance of the work which he recommends.

He cited the experience of Dayton along this line. Subsequent to the great flood of 1913, two million dollars was subscribed in order to prevent a repetition of the disaster. Engineering corps were put into the field to make investigations, but the progress was slow and the public, in particular as represented by the newspapers, became dissatisfied. It was decided thereupon to appoint a publicity man, a young engineer with some publicity experience, who would give to the newspapers the facts in the case. The false impressions were corrected and the public given the information it needed.

R. P. Bolton said the fact that engineers are engaged in certain lines of commercial work is no bar to their doing independent work and expressing independent opinions, whether they are employed by a municipality or by a private corporation or person. He objected strongly to various reflections throughout the paper, such as that on the work which has been accomplished by large business interests in this country and the suggestion that they should be limited to a certain kind of fame, and that no other credit be given to them. Nor did he see why the author should reflect on the engineers employed by financiers of that wonderful electrical industry which has set the highest standard of engineering of any other industry. The suggestion that our Society should take part in recommending or suggesting the names of engineers for appointments to municipal employment is one that has been considered adverse to the policy of our own and other societies, but a number of societies, including the leading ones, have urged the appointment of engineers as members of Public Service Commissions. Why was not that done in this city? Because the lawyers, who have swallowed practically the whole of the political positions in the State and the city, are afraid of engineers. They do not recognize what an engineer is and what he stands for. The conspicuous and highly talented lawyer who was at the head of the Government at that time stated that he did not appoint engineers because they were always technical, and in his opinion a lawyer could always grasp enough of engineering matters to understand a technical question. He did not believe that the best class of engineers could be brought into the position of taking office under municipal conditions as they are here today. However, he did agree with the author in saying that engineers as a body should take a greater interest and a greater part in municipal affairs; and with Dr. Humphreys and others in saying that engineers will not do their full duty until they recognize the fact that they are not only engineers but are citizens.

H. S. Person[1] presented a written discussion, taking up various phases of the subject of Mr. Cooke's paper. He said, among other things, that nowhere had he heard a cleaner-cut, more challenge-like utterance in this great movement than that of the author's. Mr. Cooke has been to the frontier on scouting duty, so to speak, and now returns with his report. It is at the same time an entreaty and an exhortation for the main army of his professional associates to lift up their eyes to see the problem, the opportunities and needs which he has seen in municipal administration, the field for public service particularly de-

[1] Amos Tuck School, Dartmouth College.

manding the expert knowledge of the engineer. The response should be in the form of definite plans.

These plans must embrace two main lines of operation, education of the public and of the profession. The public needs education concerning the capacity and adequacy of the engineering profession for public administration; the engineering profession, paradoxical as it may seem, needs to educate itself concerning its incompleteness and inadequacy for that service.

For such self-education, the essential requirements are two: the breaking away from the attitude of mind molded by the motive of private gain and the achievement of one molded by the motive of public service; and the development of the special science of municipal engineering. The municipal engineer must be a composite of engineer, economist, educator, accountant, statistician, executive and administrator.

In furtherance of the second phase of professional education, he agreed with the author as to the wisdom of devoting a section of the library to a Municipal Reference Library.

CHAS. DAY sent a written discussion in the course of which he said: It does not seem possible that our membership should do otherwise than accord the fullest support to those measures which will bring about the highest professional standard in the field of municipal engineering. To-day we occupy the indefensible position of permitting without protest the perpetration of obsolete, inefficient and extravagant methods with regard to municipal work involving the expenditure of millions of dollars. It seems to me that it is entirely incompatible with a proper code of ethics that we should tolerate the continuance of such abuses without giving voice to a strenuous protest. Of course, in the final analysis little progress will be made until engineers, possessing not only the requisite experience and knowledge but a deep interest in public welfare, are willing to accept municipal posts. This pertains in particular to those functions which are generally assumed by city governments, such as street cleaning, removal of ashes, highway work, etc. Probably very few of our members are engaged upon such work.

There is, however, another great field of activity closely related to municipal work which engages the attention of a large number of our members, in the work of public service corporations. Owing to the enactment of laws providing for regulation, public service corporations in many states occupy a position in relation to the public that imposes quite as great obligations as those devolving upon the departments or individuals who are engaged upon purely municipal work.

There can be no doubt that there is justification for the dissatisfaction concerning the *results which in many cases have been secured* through State regulation of privately operated public utilities. Certain of the men responsible for the policies of such corporations have lacked almost entirely that recognition of the public interest which is referred to by the author.

It may be that in most cases the responsibility for this condition rests directly upon men who are not members of our profession. Nevertheless, this does not relieve us from the duty of asserting ourselves with a view to placing the businesses to which we are the principal contributors, upon an inherently sound and permanent basis.

There can be no doubt that the type of engineer desired by the author will see that justice is done to corporation and public alike through a frank and unbiased consideration of the apparently conflicting conditions. The qualifications which in Mr. Cooke's judgment are necessary upon the part of the municipal engineer, are equally imperative for those who administer our public service corporations, and it seems to me that this Society can do no more important work than to encourage this spirit in every way within its power.

CARL SCHWARTZ disagreed with the author in his references to the difficulties in securing the professional services of engineers for municipal work, and said that he could personally furnish the names of prominent mechanical and electrical engineers not affiliated in any way with large manufacturing or conflicting interests.

The success of engineers in private enterprises is largely due to the fact that financiers have appreciation and knowledge not alone of the professional standing, since a financier is readily able to measure ability by economic results. To secure such results the engineer must not alone be a scientist, as without a good dose of business judgment he would be unfit for any leading or responsible position.

Admitting that the municipal field may not so far have sufficiently attracted the attention of the engineering profession, he thought that the cause and remedy for this condition are hardly to be looked for in the author's paper. He would refer the author to Bryce's American Commonwealth, and specifically the chapter on why the best men do not go into politics, for a perhaps more reasonable explanation. While the author does not claim that the engineer who holds a public position is in politics, still he advocates the value of advertising, and the writer objected to such publicity methods. In his opinion it would be a calamity should the engineering profession accept the suggestions contained in the paper as a guide for the important field of municipal engineering.

ALEX. DOW was in agreement with previous speakers who contended that the services of experienced men unbiased by affiliations detrimental to the best interests of the municipality could be secured for municipal work. He referred particularly to those experienced in the use of concrete, in the use of asphalt, and in the electrical industry. He believed that in none of these fields would any leading man fail to give a truthful answer to inquiries or to render a signed report that was strictly honest, provided his time and engagements permitted him to accept such a commission.

NEWTON D. BAKER[1] wrote that there are one or two thoughts suggested by Mr. Cooke's paper which he desired to emphasize. In the first place, the difficulty in having engineers with the public point of view has not been entirely with the engineers. Our American cities have not made city engineering a career in the German sense of that word, and, therefore, men who have entered the city's

[1] Mayor of Cleveland.

service and become proficient find the rewards of their professional activity greater in private employment. They soon reach the highest compensation and official dignity possible, and not unnaturally, are unwilling to arrest either their own development or their own progress by staying in the public service. This situation arises from various causes. Our American cities have only recently come to a realizing sense of the importance of accurate and expert service for engineers. The old theory was that a man who devoted half of his time to engineering and half of his time to politics was a better public servant, or at least more entitled to the job. As a consequence of this the public have regarded their engineers as political placemen and have not been willing to sanction the payment of salaries at all in proportion to those paid by private employers. Before we can expect the engineers as a professional body to change their attitude therefore, we must have on the part of the people a perfectly frank understanding that high-grade professional service cannot be expected out of a charitable impulse, but must be compensated in a dignified, adequate way by the public as an employer, and that men of real ability will not accept the public service if their continuance in it is to be interrupted in the midst of useful work on their part by the mere accidents of political change in the headship of city governments. He made these comments not because he did not think these changes are coming about, but because he thought in justice to the engineers the entire fault should not even by inference be assumed by them, and because he was very anxious to have the people of our American cities realize their share of the burden in securing efficient and high-grade service from experts.

Robert B. Wolf made a strong plea for the engineer in public service. He believed that the engineer was destined to work out the great social problems of the world as well as the industrial problems.

The word "politics" must be made to have a new meaning and the duty of the engineering profession is to make it synonymous with the highest kind of idealistic service. The reason the world must look to the engineer for a solution of these problems is that in the very nature of things his idealism is practical. His grasp of material facts and laws insures an idealism which is workable, and for this reason will be progressive in its accomplishment of social and political reforms. The fundamental, basic reason why we cannot hope to solve our social problems through our strictly religious and ethical institutions is that they are made up largely of men who have little knowledge of natural sciences. While it is true that the higher spiritual laws include the lower and material laws, it is quite true that we cannot hope to use those higher laws intelligently until we first master the lower. It is because it is the engineer's business to know and use the forces of nature that he, above all others, is qualified to solve the great vital problems of our municipalities.

F. W. Taylor wished to correct the impression that might result from the remarks of the previous speakers that the author considered the consulting engineers of the country, and particularly the electrical engineers, disqualified for consulting work for our municipalities because of their employment by the great public service corporations. Careful reading will show that the author does not say this. The author says that he had been unable to obtain the services for the city of Philadelphia of prominent electrical and consulting engineers. This is a statement of fact, for the reply of these gentlemen was, "We are retained by the public service corporations, or are affiliated with the electrical corporations and therefore not in a position to give you the advice which you seek." It is no reflection either on the integrity of these men that they were placed in a position where they could not give their services to the city of Philadelphia. If there is any reflection at all it passes back to the owners of the companies, who in nine cases out of ten are not engineers, but are financiers who believe that if the cities secure the knowledge to regulate rates, it would ultimately be to the detriment of their companies. This view on the part of the companies, Mr. Taylor did not agree with, since a thorough knowledge of the facts on the part of city officials might as readily lead to a rise as to a decrease in rates.

Charles Whiting Baker said that up to a comparatively recent date cities had been rich mines to be exploited jointly by the politicians and by the franchise-owning companies. Now the public is learning that our city governments may be brought up to the standards which have prevailed for many years in England and in Germany by taking advantage of the skill and ability of the engineer. Within the last five years there has been started the most hopeful movement for the betterment of city government service that has ever been undertaken in this country. He referred to the so-called city manager plan of municipal government. This was begun by the city of Staunton, Va., five years ago and there are now some two dozen cities in the United States which have established the office of city manager and have put engineers in charge of the work.

Besides this, it should be noted that in some other cities which have not formally adopted this plan, engineers are taking a leading part in municipal administration. The author of this paper is practically the city manager of Philadelphia and holds the most important position in municipal service of any engineer in the United States.

Robert S. Woodward[1] wrote that he was interested to observe that many of the ideas which Mr. Cooke has brought forward are similar in their import to ideas he had long held. To some of these ideas expression was given in an address read at Wood's Hole in July last at the dedication of a new laboratory of the Marine Biological Association. He was especially interested in what the author had to say in regard to the necessity on the part of the engineer of going somewhat into politics, in the better sense of the word. Before we can bring about the reform essential to further progress in society the engineer must take a hand at the problems presented. His points of view and his methods must be availed of more and more by society if we expect to make evidently needed progress.

[1] President, Carnegie Institution, Washington, D. C.

THE NEW CHARTER FOR ST. LOUIS

BY EDWARD FLAD, ST. LOUIS, MO.

Member of the Society

On June 30, 1914, the city of St. Louis by a majority vote of the citizens adopted a new charter in which the engineering profession is given unusual recognition. The charter provides for a Board of Public Service composed of a president and four directors and specifies that the president and two of the directors "shall be engineers of technical training, of at least ten years' experience, and qualified to design as well as to direct engineering work." The members of the Board are appointed by the mayor and will each receive a salary of $8000 pr annum.

The Board of Public Service has charge of all engineering, construction and reconstruction work undertaken by the city and exercises supervision and control over (*a*), the department of public utilities, including the waterworks and city lighting; (*b*) the department of streets and sewers; (*c*) the department of public welfare, including the divisions of health, of hospitals, of parks and recreation, and of correction; and (*d*) the department of public safety, including the police and excise divisions when so permitted by the State, the divisions of fire and fire prevention, of weights and measures, and of building and inspection.

The members of the Board are appointed for a term of four years and are subject to removal only for cause. Each director is given charge of a particular department under the general control of the Board.

No ordinance for public work or improvements of any kind or repairs thereof, shall be adopted unless prepared and recommended by the Board of Public Service with an estimate of cost endorsed thereon, and the Board is given authority to let all contracts for public work.

The charter provides for a measure of popular control by the initiative referendum and recall. All city officers and employees except those specifically placed in the unclassified service are appointed and advanced under the merit system controlled by an Efficiency Board composed of three members appointed by the mayor. A single legislative body is provided composed of 28 members elected from districts, and a president elected at large. The only other officers elected are the mayor and comptroller, all others are appointed either by the mayor or by the heads of departments or divisions.

The new charter replaced the one adopted in 1876. The Board of Public Service replaces the Board of Public Improvements provided by the old charter, with added duties and responsibilities.

The city of St. Louis has been singularly fortunate in having its public work controlled in the past by a board of six men, the majority of whom have always been engineers, although the charter required only one of the members to be an engineer. The provision in the new charter requiring three of the five members of the Board of Public Service to be engineers is a recognition of the valuable services rendered in the past by the engineer members of the Board of Public Improvements. The writer was a member of the board of 13 freeholders by whom the new charter was prepared.

Presented at the Annual Meeting, December 1914. Paper can also be obtained in pamphlet form; price 5 cents to members, 10 cents to non-members.

THE ENGINEER AND PUBLICITY

BY C. E. DRAYER,[1] CLEVELAND, OHIO

Non-Member

So far as we know, the first instance of systematic publicity for the engineer and engineering is the work so successfully accomplished by the author of this paper for the Cleveland (Ohio) Engineering Society. This led to the presentation of the paper of which an abstract follows and in which the author first raises the question as to what interest publicity may hold for the engineer. In the first place, the public is deeply interested in the things we are doing. People are glad to know not only of the advance in science but also about the men who make it possible and to give credit where it belongs. If then we can make use of publicity with the definite intention of placing the engineering profession in a higher position in the vision of our employer, the public, a point of interest has been found.

In the second place, we find an opportunity and duty to render service to the public by giving it dependable information about technical subjects. The ordinary newspaper uses the same reporter to write crime, politics, sport, invention, and technical achievement. An editor of one of our Cleveland papers once gave us as his opinion that one reason why news of an engineering nature does not get into the daily papers is because the ordinary reporter has not the technical knowledge to handle it. News, it must be remembered, is nothing more than ideas and facts put into interesting reading.

Here, then, are the two elements of a bargain. The public and the engineering profession have something to exchange and both sides will receive substantial benefit. The engineering profession will find itself in a better position by having the public appreciate the important service it is rendering; the public will find itself deeply interested in the information we are able to give, because it advances public welfare.

[1] Chairman, Publicity Committee, Cleveland Engineering Society, Chamber of Commerce Bldg.

Abstract of paper and discussion presented at the Annual Meeting, December 1914. Complete paper may be obtained without discussion; price 5 cents to members; 10 cents to non-members.

PUBLICITY WORK IN CLEVELAND

In the publicity work of the Cleveland Engineering Society, which has extended now over a period of two years, our first step was to get acquainted with the managing editors of the two leading papers in the city. They were told that the Society had about 500 members, many of whom are at the head of large undertakings on which the growth and prosperity of the city depend, and that the Society stood ready to coöperate with them in obtaining such engineering news as would be of interest to the community.

It so happened that the outcoming issue of the Society's Journal contained the report of a special committee on technical education in Cleveland. Naturally, a large number of people in the city were interested in what engineers had to say about their technical schools. Abstracts to make about three-quarters of a column were written, ready to set in type, and were handed to the editors of the two morning papers. They were printed without alteration. A third paper printed its own abstract and an editorial. If the committee had something to say which the public would be benefited in knowing, surely 200,000 papers with authentic information were a better medium than the 1500 copies of The Journal read largely by technical men.

Another subject of great interest to the public, although it might not appear so from the title, was discussed in R. H. Fernald's paper on The Relation of the Gas Producer to Low-Grade Fuels and Concentration of Power at the Mines. When an abstract appeared in the paper on the Sunday following the lecture, it was headlined as shown herewith:

PRODUCER-GAS TO ELIMINATE SMOKE AND SAVE FUEL

United States Engineer of Mines Tells Local Society of Broad Conservation Plan

MILLIONS OF TONS OF COAL WASTED YEARLY

Production of Gas at Mines From Coal Now Unmined Would Solve Problem

Reference to the paper printed in the Journal of the Cleveland Engineering Society will bear out the assertion that the headlines do not exaggerate the statements made by Dr. Fernald. Our task was merely to make news of plain facts. To the citizens of any large industrial center like Cleveland, smoke elimination and fuel conservation are mighty live questions. News, as was said before, is the turning of facts and ideas into interesting reading.

Probably the largest service to the community performed by the publicity committee of the Cleveland Society was the publishing of 14 inspirational articles by prominent local engineers on Engineering as Life Work. The articles appeared on successive Sundays in the magazine section of a local paper. Beneath the title of each was an editor's note stating the purpose of the series and that they were published under the auspices of the Society. Among the contributors were two past-presidents of The American Society of Mechanical Engineers and a past-president of the American Railway Engineering Association. The theme of the series was to tell the young man about to choose his life work what is before him in the various branches of the engineering profession. Besides appearing in the local paper, most of them were published in the Scientific American and the Case Tech, the student publication of Case School of Applied Science. Some appeared in other periodicals over the country. A young immigrant wrote to one of the contributors and asked for permission to translate his paper into French and Russian to send to those countries.

While we might multiply instances like the above where our work was distinctly a service rendered the public, we shall pass to an enumeration of the tangible benefits to the Society and to the profession growing out of the publicity work.

A higher standing in the estimation of the people and of those in authority in the affairs of the community is one gain. In Cleveland, the coöperation of the Society is usually sought in the solution of questions of public welfare where engineers are qualified to speak.

To cite an instance, the Civil Service Commission early in the present year asked the Society to assist it by taking charge of the preparation and marking of papers for engineering positions. The first request was for 10 examinations, and the results to both the Commission and to the Society were very gratifying. The Commission secured the service of experts at no cost to the city, but which were worth more than it had available funds to employ. The secretary of the Commission told us that the candidates were satisfied with the fairness of the examination. Concerning previous examinations complaints have been made that proper relative weights had not been given to experience and theoretical training. Our publicity committee saw to it that the public learned through the newspapers of the arrangement between the Civil Service Commission

and the Engineering Society. Credit was given where it was due.

Somebody has said that the public is unreasonable only when it is uninformed. It is hardly possible that any sudden gust of public disapproval would arise where engineers are concerned if the public felt that it was well acquainted with them. When the local society engages in publicity work, a revival in the interest of its members in the activities of the society will be apparent. The indifferent members find they have some pride in their society when its activities, of which they approve, are described in the daily paper. It is said on good authority that the publicity campaigns undertaken by Memphis and Des Moines, to present to business men their advantages for a location, resulted in a renewed city spirit equal in value to the new business acquired.

Due largely to the publicity work, there has been a substantial increase in percentage of attendance at the meetings. One estimate was 15 per cent. To stimulate attendance, the committee furnishes the papers advance notices of the meetings, consisting of a picture of the speaker and some 150 words of text telling about him and his subject.

During the last two years some 250 new members have been added to the roll, an increase of over 50 per cent in a society past 30 years old. Of course, it is difficult to say just what per cent of increase in an organization recently very active in all its functions may be credited to publicity work.

It is possible at this time to know only the general nature and approximate limits of publicity with any degree of accuracy. We can, however, enumerate the various channels by which information of an engineering nature may be placed before the public. It is also possible to give approximate relative values to them. In the matter of choosing mediums we are inclined to lay down this broad general principle: When one man has something to tell another, the telling of which will do them both good, he may employ the most direct honorable means. It may be either the written or spoken word.

Under the written word we would include newspapers, periodicals, such as national magazines, and pamphlets. The spoken word would be confined to a rather narrow field and would consist for the most part of talks by engineers before high school classes, classes in Y.M.C.A.'s, lectures before clubs, at special gatherings in churches and the like.

We have shown that the public and the engineering profession are in a position to make an exchange at a profit to both parties. A record of results in one locality where it has been tried points to what may be expected through coöperation in a larger field. Mediums of exchange have been discussed. There remains yet to be suggested a preliminary plan by which systematic and effective work may be done.

Inasmuch as all the profession will share in the benefits of a closer relation with the public, we assume that the efforts of all should be united on a common ground. More definite plans may be worked out by representatives of leading national engineering organizations at such a time and place as is deemed best. In general we believe that the local society working in coöperation with a central national organization will produce the most satisfactory results.

DISCUSSION

A. J. Himes in a written discussion stated that publicity should eliminate error from the mind of the layman and of the public concerning engineering and thus clear the way for a proper utilization of the engineer's services. Many people are handicapped in their desire to make use of the wares of the engineer because they cannot talk with him familiarly of the things which they desire to do.

It is a waste of time to deny either the need or the value of advertising. But among professional men the subject is hemmed in with so many restrictions that engineers hesitate to make use of such a method of securing business.

Professional men have always considered it proper to reap the advertising rewards that come from their activities in societies and public affairs. It is doubtless true that a paper of unusual value, because of the information that it contains and the excellent work of its author, is much better as an advertisement than a paper of less merit, with smaller chance of adding to the general knowledge, and which may be presumed to be written chiefly for advertising purposes. It is rather difficult to discover the motives which have prompted a man to go to the trouble of writing and presenting a professional paper and no microscopical examination of such motives is worth the effort.

An important error is made when one concludes that legitimate professional advertising is limited to the writing of a paper.

The profession suffers from certain misconceptions of its patrons, including the public, from among which I will enumerate four as follows:

First: It frequently happens on some important work that the preliminary estimate of cost is exceeded in the construction. For this the engineers are roundly denounced. The truth, which never appears in print, is that many such works are completed within the estimate; that where the estimate is exceeded, the cause is frequently a change in plan or increase of quantities for which the engineer has no responsibility whatever; in other cases estimates are stated by men in authority to contain provisions which have not been included; and on some occasions the difficulties encountered are beyond the powers of human foresight.

Second: There is frequently an unreasoning demand for the beginning of construction immediately after an appropriation is made without any regard for the necessity of first making surveys and plans. Of this the Panama Canal was a notable example. The evils attendant upon such a course need not be pointed out to engineers.

Third: Bombastic and unwise laudation of engineering achievement has developed a popular idea that engineering is mathematically precise. In court and before legislative bodies engineers of prominence are sometimes led to declare their ability to determine by formula and with precision

things concerning which it is only possible to make general deductions. Stresses in rail joints may be cited as an example.

Fourth: In the general discussion of the government valuation of railroads, the statement has been frequently made by men in the councils of the nation that the opinion of an engineer is incompetent testimony in valuation proceedings except where it relates to actual quantities which he has measured himself.

It is unnecessary to point out the absurdity and injustice of these misconceptions, and the very great injury which results therefrom to the whole profession. The purpose is to call attention to the necessity for publicity, a publicity that will give to the layman a knowledge of our work.

If the public knew that plans once made are seldom changed without increased expense, it would be demanded of its servants that plans should be made in accordance with the original estimates and then carefully adhered to. It would become important that the first estimate should be right, and that when exceeded the reason therefor should be sound. If it were recognized that some things, as, for instance, rail-joint stresses, were beyond the powers of mathematical analysis, engineers would not be condemned because such stresses have not been figured; or that engineers had followed every step of construction work, from the wielding of a pick and the swinging of a maul to the development of the whole program for the construction of a thousand miles of railroad and the cost accounting therefor, then no judge or statesman could make the public believe that the best results in valuation could be secured without free use of engineering experience.

The public mind can only be disabused of these misconceptions of engineering work and the people be supplied with correct ideas of the possibilities and the limitations of engineering art, by publicity.

The mass of rubbish published every day in the newspapers is an appalling evidence of the paucity of worthy thought among those who cater to a need for information. The country is burdened with the wasteful and wanton exploitation of engineering skill. It is time for the profession to assert itself. Engineering projects of public importance should be passed upon by the engineering societies.

Every medium at the command of the engineer should be used and correct information about engineering work placed before each citizen. The profession should be made familiar to all who have an interest therein, and it is rightful to expect that the increased respect and confidence arising from a more intimate knowledge of such work will greatly enhance its material prosperity.

Coöperative advertising by engineering societies conducted on broad lines for the benefit of the public and so as to put the profession on a more substantial basis, is an aim that is worthy of the highest traditions of this Society.

H. McDonald in a written discussion stated that the engineers of Cleveland were fortunate in having among their number one who in addition to his engineering skill, possesses the taste and willingness to clothe bare technical facts in such garments that they challenge popular attention and interest. If each community were equally fortunate, publicity on engineering matters would be easier.

Few engineers possess this gift or the willingness to devote their time to the task. Many are quite decided in their opinions that there is no need of publicity. They proceed upon the well established theory that virtue is its own reward, and are usually compelled to content themselves therewith.

The writer strongly advocates the participation by engineers in public affairs. They are qualified to guide public policy in matters where their training is of value, but as a class, they have so far failed to convince the public that such is the case.

Their position as a class has been that of an instrument in the hands of other men, who have made a specialty of the study of mankind rather than physics. If engineers can master technical details, they can also learn the laws that contról human actions. Recognition is not to be altogether obtained by keeping ourselves and our work before the public in newspaper columns, but by earnest and effective work as organized bodies in every community. That work should consist of watching carefully the manner in which the public affairs involving engineering are administered, taking vigorous organized action looking toward the stopping of the waste of public moneys and graft, and the shaping of legislation involving engineering and industrial matters.

The public should be convinced that we are willing to aid in the proper adjustment of such matters and to give, without selfish motive, sound advice on matters of public policy and the opportunity will not be lacking. A reputation for fearlessness and honesty must be reëstablished and maintained.

Instances are not lacking where professional opinions have been subordinated to the demands of commercialism. Public officers of to-day have difficulty in finding engineers upon whom they can rely for unbiased advice on matters in which organized capital is affected. To merit and obtain confidence engineers must be willing to tell the truth under all circumstances.

It is only such a professional reputation which warrants engineers in making themselves the sole arbiters in preparing specifications, and to preserve that reputation its requirements must be lived up to.

Charles Whiting Baker said that the engineer needs to learn the lesson which is taught by this and Mr. Cooke's paper, of the value of publicity. If the engineer wants to get support for what he is doing, he must know how to reach the ear of the public in the right way. He spoke of the valuable service which had been rendered the street cleaning department by Colonel Waring, who was an engineer. One of his first steps was to put the street cleaning department into white uniforms. The publicity went all over the country and made the department known as it had never been known before and gave the employees a new respect for themselves. This is an instance of what a proper appreciation of publicity may do in a wise engineer's hands.

E. H. Whitlock said that it had been his good fortune to watch the results accomplished in Cleveland by Mr. Drayer during the last two years and that he could heartily commend the work done there. Publicity can be differentiated from advertising. It meets the demand on the part of the public for information as to engineering facts, and who can give this better than the engineer?

Calvin W. Rice thought that it might interest the members of the Society to know that special pains are being taken along publicity lines. Over 60 technical and daily papers in the United States are given copies of everything that we publish and have read at our meetings. In addition special work had been done for this meeting and one of the papers had published over a column in every issue this week.

The Author said that the correct test of publicity was the results obtained. Any plan of publicity must be consecutive, it must continue for a period of time. Enough material has been presented before the Society at this and the session of Wednesday evening to occupy the time of a good publicity man for six months. He must, however, work from the standpoint of the newspaper man. Journalism is a profession; it seeks to give the public knowledge that the public wants. Engineering information must be given to the public on a definite plan, otherwise the newspapers will not give us much attention.

SNOW REMOVAL

A REPORT OF THE COMMITTEE ON RESOLUTIONS OF THE SNOW REMOVAL CONFERENCE HELD IN PHILADELPHIA APRIL 16 and 17, 1914.

Early in March 1914, Mr. Morris L. Cooke, Director of the Department of Public Works, Philadelphia, wrote to a number of the leading Eastern cities suggesting the need of a conference on the subject of snow removal and pointed out, that in view of the very apparent lack of engineering methods generally employed in a problem which so clearly calls for engineering study, it might be profitable if those in charge of the matter of snow removal in the larger cities could be brought together, and that at least an approximation of a definite policy of snow removal might result from such a meeting. The suggestion met with such favor that a snow removal conference was held in Philadelphia on April 16 and 17, 1914.

A Committee on Resolutions, J. W. Paxton, chairman, was appointed to submit a report, which would be the result of papers, discussions and recommendations made at this conference, and the Committee makes the following report:

The problem of snow removal must obviously be considered differently in different cities as its solution is dependent upon such variable elements as climate, population, width of streets, density and character of traffic, location of sewer systems, available disposal places and other local conditions, to say nothing of the financial policy of the municipality.

It would seem impossible to formulate anything but the most general suggestions, and yet it is found that even so vital a matter as the financial policy does not affect the main problem, except in the extent of the work.

The work of snow removal is generally done by contract under the supervision of city officials, payment being made according to the quantity removed as tallied by wagons hauling to the disposal dumps, the forces and equipment consisting of men with shovels, horses and wagons. In some cities, scrapers and plows are used to push the snow to the side of the street, relieving traffic and making it easy to pile, or to load without piling.

Salt is generally and very extensively used for the removal of snow in Liverpool, London, Paris and other European cities. The very general practice is to broadcast coarse salt on the streets during and immediately after a snow storm, and when the snow has been reduced to slush by the action of the salt, the streets are flushed with water and the slush washed down the sewers; but in those cities they do not have very heavy snows and it is doubtful whether it would be practicable here where we have a much greater depth of snow. There is also very serious objection to the use of salt by the Societies for Prevention of Cruelty to Animals and in some of the cities it is prohibited by ordinance. It is questionable whether the use of salt has been given a fair trial in this country for the removal of snow and there is little doubt but that it would be useful in light snow storms.

Much thought has been given to the design of apparatus for melting snow and, also, to special machinery for scraping, loading and transporting. Inventors, designers and manufacturers should be encouraged to continue in the endeavor to produce equipment which will render practical and efficient service, but the amount of snow is so variable and the equipment is in use for such a short period of time that it is desirable it be designed to be useful for other work at different seasons of the year.

The problem confronting the public officials is the removal of snow in the shortest time in such a manner as not to interfere with traffic, and at a minimum cost. Therefore, using the method of scraping, shoveling into trucks or carts and hauling to dumps, the length of haul becomes a most important factor and it can readily be seen that the utilization of sewer manholes as dumped, and the sewer system to carry the material to the rivers, is the most economical method which can be devised as it reduces both the haul and the handling to a minimum. The authorities in charge of the sewer systems have, as a general thing, apprehensions regarding the use of the sewer as a snow carrier. The Borough of Manhattan, New York, Bureau of Sewers, however, made experiments during the winter of 1914 which seem to prove that, within certain limits, such apprehensions are ill-founded.

Abstract of paper and discussion presented at the Annual Meeting, December 1914. Complete paper may be obtained without discussion; price 5 cents to members, 10 cents to non-members.

Gas and chemical combinations in the sewers have little effect on the rate of melting. Two cubic yards per minute is the maximum rate at which snow can be shoveled into a 24-in. manhole. Tidal sewers can only be used to advantage when the tide is low, in which case the factors of the ordinary sewer applies. Siphon sewers can be used as well as the ordinary type.

Where difficulty is experienced with an insufficient flow in the sewers, or where the flow decreases or stops, the water plug may be opened in the drainage area of the sewer above the manhole in use, until the volume of water is sufficient to carry off the snow, but it has been found that the most efficient use of water may be had where water jets are constructed in the manholes into which the snow is dumped. The problem of getting the material into the manholes in the least time with the least interference with traffic opens up a field for the consideration of a special form of manhole to be used satisfactorily for this purpose. Pittsburg and St. Louis both use a special form of manhole.

The Committee gave further an account of the work of snow removal in the cities of Philadelphia, New York, Boston and Scranton, and also of the Public Service Railway of New Jersey, and the Pennsylvania Railroad Company, on which they base the following conclusions:

1st. The plan of organization and the system to be employed should be worked out in advance of the snow season. This preliminary work should involve: (*a*) a plan of coöperation among all branches of the municipal government; (*b*) the formation of a skeleton organization composed of all the available city forces, such as engineers, inspectors, time-keepers, laborers and teams; (*c*) the division of the city into zones and the determination of a definite method of work for each zone. The various members of the organization should be assigned to these zones and the responsible officials familiarized with the duties expected of them.

The character of work to be performed in the different zones may consist merely of the regulation of opening cross-walks and gutters and otherwise generally assisting pedestrian traffic and the run-off of the snow, or it may consist in the complete removal of the snow from the streets. Owing to the general increase in motor traffic and the concentration of business in definite office districts and to the general public demand for increased urban facilities, the present tendency is to increase the scope of the work involving the complete removal of snow from all main thoroughfares and business streets.

2nd. Removal work should commence as soon as the snow has covered the pavements and the indications point to the storm continuing, and should be carried on continuously. This as a principle is successfully followed by street railways and by some cities.

3rd. The carrying capacity of the sewer system should be utilized as far as possible.

The use of the sewers which reduces both the haul and handling to a minimum involves two operations: namely, getting the material to the catch basins or manholes, and then putting the material into the sewers. The first operation can best be done by loading into wagons or trucks and hauling to suitable manholes or by the use of scrapers or graders. The problem of getting the material into the manholes in the least time and with the least interference with traffic opens up a field for consideration of the question of special forms and special locations of manholes designed to be used solely for this purpose.

The method of flushing the snow with fire hose into catch basins may have a limited application but it is too unreliable to have any general value as it depends on weather conditions.

4th. When practicable, where there is only a small area to be cleaned, the work should be performed directly by the municipality by day labor. This method of operation is the most flexible and the most easily administered and it obviates the necessity of measurements and checking involved under the contract system. The work can also be performed by day labor in large areas by adopting the following method: The department to advertise and go out into the open market and hire teams to haul the snow for so much per yard, the price to be determined by the department and to represent a fair estimate of the cost of the work and a fair profit. This, of course, would throw the work open to anyone owning one team, or a hundred or a thousand or more teams, depending upon the amount of work to be performed, and would not leave the department dependent upon any one or more contractors. In this method, as well as when the work must be performed by contract system, a method of measurement as simple and accurate as possible should be used. The practicability of having work done by the municipality will depend among other things on the immediate availability of an appropriation. It is essential for the proper conduct of the work whether by day labor or contract that appropriation for snow removal should be made in advance of necessity for the work.

5th. Coöperation should be sought with the traction companies and use made of adjustable plows and sweepers to open roadways adjacent to street railway tracks at the time that the work of clearing the tracks is being carried on.

6th. Effort should be made to obtain the coöperation of the public and to instruct the householders

in the method of the removal of snow from private premises in such a way as to least impede the city's work. Where sidewalks are of greater width than would be necessary to handle the reduced volume of pedestrian traffic, which may be expected after a heavy snow, the snow instead of being entirely cleared from the sidewalk and piled in the roadway should be left on the sidewalk near the curb line to be later removed by the city when opportunity presents itself.

7th. The police force of the city should coöperate with the street cleaning force and the services of patrolmen as inspectors should be utilized as far as possible. The police in particular should give attention to the enforcement of regulation governing the removal of snow from the sidewalks or from a portion thereof.

DISCUSSION

J. T. Fetherston,[1] in a written discussion, remarked that New York City has tried almost every method of contracting for snow work, from the area system to the direct haulage method on vehicle capacity basis. Dividing the city into relatively small districts, larger districts and boroughs has been tried, and it would appear that the responsibility and experience of the contractor were of greater importance than the area or district assignments. In other words, an experienced contractor, with the nucleus of the necessary snow removal equipment, as a rule is in better shape to remove snow rapidly and control sub-contractors than is the municipality. More important still, he usually has sufficient control of funds to pay promptly all men employed. It would seem that experience, control of equipment and responsibility are the main factors to be considered, rather than the area basis, for the assignment of contracts.

The statement of general principles contained in the Committee's report would be clarified if the work were separated into these divisions: (1) contract work, (2) street railway assignments, (3) municipal work. Necessarily under each head should be given the plan, and every reasonable contingency covered by the assignment of the most suitable means of snow removal adapted to particular areas, streets or districts of the city under consideration. All municipal departments should be called in to assist the street cleaning division by the assignment of officers for the supervision of contract work particularly, leaving the street cleaning department as free as possible to perform the work for which its own force is best fitted.

As a general comment on the committee report, it is suggested that, if possible, engineers or street cleaning officials should receive from an authoritative source, such as the Society, a summary of conclusions covering:

(1) A statement as to what types of streets should be cleared of snow, and how far the municipality is justified in removing snow from minor thoroughfares at public expense.

(2) A statement setting up the reasonable depth of snow for which a municipality should have equipment available, and in general the time limits within which streets should be cleared, so as to avoid economic loss. Coupled with this, a maximum depth of snowfall beyond which all citizens and transporting agencies should be required to place their services at the disposal of the municipality at cost.

(3) A compilation of snow statistics for various parts of this country, and if possible a summary of attending weather conditions.

Each city must work out its own salvation regarding snow removal and disposal methods. The problem is so complicated by uncertainty as to weather conditions that no particular method is best fitted for all cities and all conditions.

[1] Commissioner, Dept. of Street Cleaning, New York.

E. D. Very[1] in a written discussion pointed out that an endeavor should be made to define the extent to which snow removal should be carried on in a municipality. This definition should not be made in units of mileage or of square yardage but rather in terms of necessity. In this regard the financial policy so affects the main problem as to deserve considerable study, as the extent to which the work shall be carried on depends largely upon the amount of money a municipality can afford to spend. This question must be answered before we may assume that the area to be cleaned has been decided upon and the appropriation of money must be predicated upon an understanding of the actual need in this regard. We should go further and discuss the manner in which funds for the work should be raised. It is suggested that the tax for such purpose should be levied; a part by a general tax and a part by tax on property immediately benefited. Such a method would restrain the indiscriminate demand for unnecessary service for personal benefit.

Whether the work is to be done by contract or by the municipal forces is a question of local condition and must be solved independently by each locality. It is well to remember that where the force engaged in removing accumulations in the street has also the duty of removing the household wastes, the latter item must be considered as of equal importance with the former and the force employed in the latter work must not be reduced by transferring any part of it to the performance of the former. This is especially true when the use of sewers is to be made for the disposition of the snow, as if wastes are not removed they will find their way into the snow bank, and so become a menace in the clogging of the sewers.

For the purpose of supervision, the division of the work into districts is the proper method but to limit a contractor to one district is of questionable value provided the contractor is able to handle more than one district. The fewer contractors on a given area results in less friction, and labor and vehicles are more easily distributed where there is a common interest in the success of the whole work.

Where the work is performed by contract it is well to confine the contractor to the removal of the large accumulations and to employ a municipal force in clearing crosswalks, keeping catch basin inlets open and removing snow from the immediate vicinity of fire hydrants.

If this conference does nothing else but successfully impress the officials in charge of sewers that it is their duty to permit the free use of the sewers for the disposition of snow, it has given ample reason for its existence. Flushing snow into catch basins is not favored as it has not been proven that such work may be practically accomplished without interfering with the necessary use of these devices.

As to the hiring of teams by the city for snow removal,

[1] Sanitary Engr., 17 Battery Place, New York.

it is believed that this is a matter of local condition. New York City has had sad experiences in that line.

As to having an available appropriation for this work, the idea of municipal policy today is to suspect the official of not being worthy of trust in the handling of money, so they limit his appropriation to his actual needs and where the amount which he may need is indeterminate, they hesitate in taking any chance of putting an amount in the hand of the official more than sufficient for his needs for fear that he may spend more than is required.

Police assistance would be most valuable and in the matter of enforcement of sidewalk cleaning regulations the police find themselves very busy but moderately successful. An amendment is suggested that coöperation of police magistrates be employed to the end that police activity may be made effective.

W. GOLDSMITH[1] called attention to a statement in the report where mention is made of enlarging manholes for the quick disposal of snow. In the Manhattan experiments it was shown that two cubic yards of snow per minute can be shovelled into a 24-in. manhole and that 2560 cubic yards were dumped into one sewer by means of three manholes in an eight hour day. This seems to indicate that a 24-in. manhole is large enough. Besides, the effect of an enlarged manhole on the pavement must be considered, the majority of defects in street surfaces being due to manholes of one nature or another and it seems that the elimination rather than an increase of these enemies to pavements should be striven for.

F. KINGSLEY pointed out the fact that the same old cart-and-horse methods for snow removal seem to be used that were adopted when the problem became serious some twenty years ago. It is interesting, however, to note the success of the snow-melting device on the Pennsylvania Railroad, because the melting of snow seems to be the most likely path along which improvement can take place.

The cost of fuel to melt snow is only some 15 per cent of cost of handling it under present methods. The basis for this is that a cubic yard of snow as removed weighs approximately 1000 lb. and would require about 200,000 B. t. u. to reduce it to water, allowing a liberal margin over the latent heat of ice. Coal at $4 per ton provides about 67,000 B. t. u. for one cent in a perfect furnace, or 27,000 B. t. u. with 40 per cent furnace efficiency. At the latter rate the fuel cost for melting would only be 7½ cents per cubic yard or 15 per cent of the present apparent cost of handling it. This does not include interest or labor charges but these ought not to be insurmountable obstacles.

The problem is peculiarly one that mechanical engineers should be able to solve. It appears to be largely a balancing of the cost of heating surface against interest charges, and 1 sq. ft. of heating surface can transmit heat (as demonstrated by existing locomotive boilers) at an approximate rate of 20,000 B. t. u. per sq. ft. per hour. With less efficient but more rapid transmission, twice this rate does not seem impossible. On this basis, apparatus capable of melting 100 cubic yards of snow an hour would require 500 sq. ft. of heating surface. Certainly there is nothing abnormal involved in the provision of heating surface in such amounts as this.

[1] Asst. Eng., Dept. of Public Works, New York City.

One hundred cubic yards of compacted snow appears to be equivalent to about 450 cubic yards of snow as it falls, and in a 3-in. snowfall this amount would cover 500 linear feet of street. The subject obviously seems to be one that is worth consideration by the various cities in the country. It would be interesting to see some thoroughgoing experiments along this line.

THE HANDLING OF SEWAGE SLUDGE

BY GEORGE S. WEBSTER,[1] PHILADELPHIA, PA.

Non-Member

Usually the first processes of sewage treatment consist in the removal from the sewage of the solid matter in suspension by means of screens or by sedimentation in tanks or basins. When more refined treatment is required it consists in the oxidation of the liquid portion of the sewage together with the fine suspended matter not susceptible to settlement. This latter phase

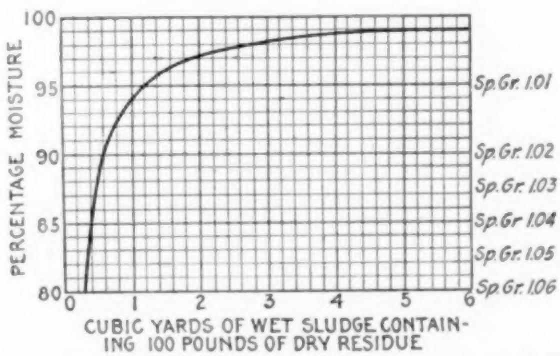


FIG. 1 RATES BETWEEN BULK OF WET SLUDGE AND ITS PERCENTAGE MOISTURE

of the sewage problem will not be considered in this paper.

In sewage treatment, the material collected on the screens and the deposit in the bottom of sedimentation tanks is called sludge. As removed from tanks it is a dark, slimy mass, containing about 90 per cent moisture, and its consistency is such that it cannot be shoveled but can be readily pumped.

Experience with sewage works indicates that upon an average 1000 persons produce 45 tons of dry solid matter per annum. If this were deposited in tanks as sludge containing 90 per cent moisture it would make 524 cu. yd., but if the sludge contained 95 per cent moisture its volume would be 1060 cu. yd., or about double the former amount. In other words, every ton of dry solid matter contained in sludge 90 per cent moisture which is removed, requires 9 tons of water to be conveyed with it, and if the sludge contains 95 per cent moisture, it requires 19 tons of water to be handled.

[1] Ch. Engr., Bureau of Surveys.

Abstract of paper and discussion presented at Annual Meeting, December, 1914. Complete paper may be obtained without discussion; price 5 cents to members; 10 cents to non-members.

One of the most important considerations, therefore, in handling sludge is the percentage moisture which it contains, as this is a controlling factor in its bulk. It is highly desirable to obtain sludge with as low a moisture content as possible (Fig 1).

Discharges of Wet Sludge in the Sea. Large cities located near the ocean dispose of the wet sludge most economically by carrying it to sea in specially constructed tank steamers. The sludge is pumped from the sedimentation tanks to reservoirs on the wharf from which the steamers are filled by gravity. When the boat reaches the dumping ground in the open sea the outlet valves are opened and the sludge diffused in the sea water as the boat moves along.

Depositing Wet Sludge on Land. For cities situated inland such method of disposal is impracticable on account of the transportation charges and they are confronted with the problem of reducing the bulk of the sludge by removing the water, either by drainage and evaporation on drying beds or by mechanical processes such as presses and centrifuges and of handling it so as to minimize offense.

The type of sedimentation tank adopted, the use of chemical precipitants or the opportunity afforded for sludge digestion have a marked effect upon the volume of sludge produced on account of the moisture content. Generally speaking it may be said that chemical precipitation will produce between 20 and 25 cu. yd. of wet sludge containing about 92 per cent moisture from each million gallons of sewage treated; plain sedimentation from 4 to 7 cu. yd. between 87 and 93 per cent moisture; septic tanks from 1.5 to 3.0 cu. yd. between 80 and 90 per cent moisture; and Emscher or Imhoff tanks from 1 to 2.5 cu. yd. between 75 and 85 per cent moisture.

The disposal of wet sludge without prior dewatering may be accomplished by its application to land in several ways. The earliest method used was called lagooning in which case earth embankments were built enclosing an area of suitable land and the wet sludge run into a depth of as great as 10 ft. The clogging of the soil preventing free drainage of the moisture, the scum formation upon the surface retarding evaporation, and the frequent great depth of the sludge, all tend to prevent the sludge from drying.

To overcome these objections and to dispose of the sludge more quickly, it was run upon the surface of farm land to form a shallow layer which would dry in a reasonable time and could then be plowed in and the field cultivated. But the gross nuisance created by the exposure of such large areas of foul smelling sludge led to the adoption of what is called trenching. As practised at Birmingham, England, the trenches were dug about 3 ft. wide and 18 in. below the surface of the soil, the excavated earth forming banks between the trenches so that they can be filled to a depth of from 24 to 30 in. with wet sludge, after which the tops of the earth banks are thrown over the sludge to prevent nuisance from smell or flies. The porous earth absorbs the moisture and later the land is plowed across the trenches and placed under cultivation. This process can be repeated at intervals of from 18 months to two years.

This method is not being used in new plants and is being abandoned in old plants on account of the area required, the interference which is caused in times of heavy storms, the increased difficulty of operating caused by winter weather and the general cumbersomeness of the method.

Mechanical Processes for Dewatering Sludge. Among the early mechanical methods of reducing the bulk of the wet sludge by dewatering was pressing in machines which consist of a number of cast-iron plates generally 9 sq. ft. in area with corrugated faces and surrounded by a machined rim so that when placed together they form water-tight cells 2 in. thick. A central pipe about 6 in. in diameter extends through the middle. Over each plate a canvas cloth is placed and sludge forced into the press and subjected to a pressure of from 60 to 75 lb. per sq. in. This squeezes the water out and the resultant cake contains between 50 and 65 per cent moisture and is about one-fifth the bulk of the original wet sludge.

It is necessary to add to the sludge before pressing from ½ to 1 per cent of lime, the fine particles of which facilitate the passage of water, the dissolved lime agglomerating the solids of the sludge.

Another mechanical method of dewatering sludge is by means of centrifuges which occupy less space than presses and do not require the addition of lime to the sludge. Such machines are continuous in action and the work of extracting the moisture consists of two distinct and constantly repeated periods. During the first period the wet sludge is introduced into the machine and by the action of centrifugal force the moisture content reduced. During the second period the sludge thus partly dried is automatically ejected. The final product contains about 60 per cent moisture and occupies about one-eighth the volume of the wet sludge.

Digestion of Sludge. In the methods of sludge handling above described efforts were directed toward preventing the dissemination of the foul odors from the wet mass. Within recent years much thought has been given to devise processes of treatment by the digestion of the putrescent matters to produce an inoffensive sludge both as withdrawn from the tanks and during drying.

One of the methods to accomplish this purpose is to remove the freshly deposited sludge from the sewage sedimentation tanks at intervals and place it in separate tanks. Usually a scum forms upon the surface beneath which more or less active fermentatation and decomposition develops. New sludge is added and digested sludge withdrawn from time to time and placed upon underdrained sand or cinder beds for dry-

ing. On account of the digestion of the sludge it dries more rapidly and is much less offensive than fresh sludge.

For the last 20 years it has been known that the retention of sludge in the tank in which it is deposited, which is known as the septic treatment of sewage, resulted in the reduction of the bulk and offensiveness of the sludge, but experience showed that while the sludge was benefited, the water leaving the tank, known as the effluent, was seriously fouled by the decomposition of the organic matter in the sludge.

The separation of the digesting sludge from the settling sewage was adopted with certain modifications by Dr. Imhoff of Essen, Germany. Two-story tanks of this type are known as Emscher or Imhoff tanks. Their extensive introduction in Germany and America is due to the fact that when properly operated they efficiently free the sewage of its settleable solids, yield a fresh inodorous effluent, produce sludge that is inodorous, of low water content and consequent small bulk.

The principles involved in the construction of the Emscher tanks are shown in Fig. 2. The sewage to be settled flows longitudinally through the tank in the cross-section marked *A*; the solids which settle upon the sloping bottom *B* slide down through the slots *C* into the sludge chamber *D*. The gases of decomposition are prevented from entering the upper chamber by the gas baffle *E* but find free exit through the sides at *F*, in which also a scum forms. A pipe *G* extends from the bottom of the sludge compartment to the outside. A quick opening valve at *H* located at a distance of over 3 ft. below the water surface in the tank permits the discharge of the digested sludge by hydrostatic pressure without any pumping. The sludge is placed upon the drying bed, which is composed of a layer of fine sand supported by a layer of cinders or pebbles and underdrained by the tile.

Dried Emscher sludge is suitable for filling low land or use in agriculture, particularly in lightening heavy soils, as it is very spongy in texture due to the entrained gas. But experience has demonstrated that the use of air-dried sludge from any source will not give results comparable with those obtained from the use of artificial fertilizers.

Recovery of Ingredients from Sludge. Sludge contains ammonia, phosphoric acid, potash, grease and carbon. Generally speaking these ingredients are more costly to recover than they are worth. It has been estimated that the manurial value in the excreta of one person in a year is \$2.62, but in the dilute sewage of America this would be contained in about 36,000 gal. of water. If this material is deposited as sludge of 90 per cent moisture it would weigh about 1720 lb. per cu. yd., and each cubic yard would contain only about 80 lb. of organic matter, of which only a part has any monetary value.

The problem of recovering the valuable ingredients in sewage sludge, therefore, involves the use of economical and efficient processes for drying or pressing to reduce the bulk for transportation; also in order to recover the grease in sewage with present methods, it is necessary to have the sludge in a very dry condition.

Where refuse disposal plants and sewage treatment works are located in close proximity to each other, an opportunity is offered for the advantageous disposal of sewage sludge by burning it with refuse.

The most serious part of the problem of sewage disposal is the handling of the sludge which results from every known method of treatment. It is possible that in the future, in order to meet higher standards of hygiene and cleanliness, methods may be devised for

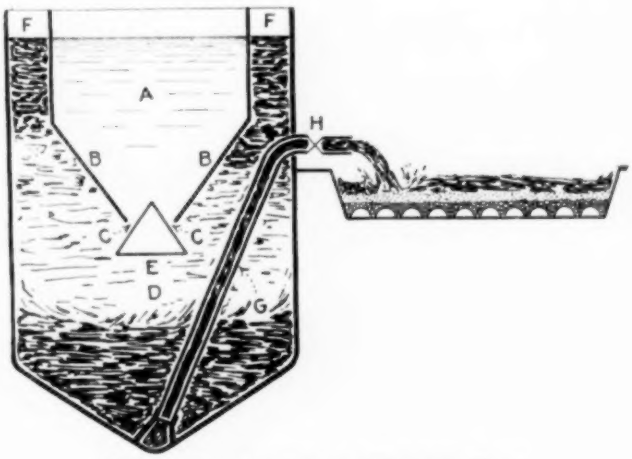


Fig. 2 Construction of Emscher Tank

intercepting sewage solids as near their place of origin as possible, and before they have become offensive, and also to recover practically all of their ingredients which have value prior to their breaking up and in part entering into solution.

This prompt removal of organic matter from sewage will also aid greatly in the prevention of the pollution of the water courses, and will tend to promote the public health and comfort.

In his paper, the author gives data upon several installations in different cities, here and abroad, in addition to the summary of methods of handling sludge which has just been outlined.

DISCUSSION

C. W. Hendrick,[1] in a discussion of the subject, remarked that the plant at Baltimore is located so that the entire operation is by electricity produced by the flow of the sewage, enabling them to handle the sludge by sludge pumps at a minimum cost. Having this power available, they move the sludge from the separation tank to the digesting tank at frequent intervals before the digestion in the separation tanks becomes a factor.

They deliver the digested sludge at about 90 per cent moisture to their customers by gravity, the wagon driving under

[1] Ch. Engr. Sewerage Commission, Baltimore, Md.

the supply pipe. This reduces the cost of delivery to practically nothing. Where the supply runs ahead of the demand, they pass the liquefied sludge to underdrained sand beds, where it is dried and then sold as fertilizer. In this way they are selling the liquified and dry sludge as rapidly as they are manufacturing it.

About 4 cu. ft. of 90 per cent sludge per person per annum are produced in their separation digestion tanks. In their efforts to produce a market for this sludge, they have tried to meet all the conditions of the demand. Some are taking the sludge at 90 per cent moisture, others wish it in the dry state, and others are considering using it as a commercial filler in fertilizers and require about 15 or 20 per cent moisture. By the use of a centrifugal drying apparatus, known as a direct heat dryer, they have been able to extract the moisture down to about 18 per cent.

W. L. D'Olier said that the author had so aptly defined the problem in his conclusions that he could not refrain from quoting them: "The most serious part of the problem of sewage disposal is the handling of the sludge." Therefore, this part of the problem of sewage disposal is an important feature in determining the method of treatment. "In order to meet higher standards of hygiene and cleanliness, methods may be devised for intercepting sewage solids as near their place of origin as possible." This is a well expressed thought. Means for such methods are available and are more and more recognized and adopted. He referred to fine screening methods. He agreed with the author that an effort should be made to recover practically all of the ingredients of the sewage solids which have value prior to their breaking up and entering in part into solution, which value is lost with the comminution, disintegration and dissolution of the solids.

In referring to the handling of digested sludge, he stated it is the common practice to select sludge beds, which, at the best, are a local nuisance; the working age limit of these sludge beds before they become impregnated is now recognized as a factor and the care and maintenance of these beds must be of a high order. Further, with the growth of our cities and the necessary increase of sewage, increased area is required and the cost of handling of the sludge onto and off the beds must be considered. In our northern climate, we are also confronted with the abandonment of the use of the beds for a term of months during winter which necessitates the additional cost of providing tank storage capacity.

These facts and features existing with sludge bed practice have urged the mechanical treatment of sludge. The results to date show effective work, but first cost, upkeep, and operating costs have been excessive. A rotary sludge filter developed abroad, now being exploited in this country, promises to lessen costs materially, and represents an important step in mechanical treatment of sludge. The speaker said the values are spent in digested sludge. Sludge from fine screens contains its manurial values and from tests abroad a net return to the plant can be effected by the treatment of sludge for by products.

The Author in closing said that whatever process was used in treating sludge or caring for sludge, it should be remembered that a plant is not automatic and it requires constant maintenance at all times on the ground.

TRAINING FOR CITY EMPLOYES IN THE MUNICIPAL COLLEGES OF GERMANY

By Clyde Lyndon King,[1] Philadelphia, Pa.

Non-Member

This paper is the result of a close study of the educational methods of Germany with special reference to the facilities and requirements for training for municipal service. The paper discusses in detail the reasons for the thorough training which is provided, the various groups of schools and colleges available for the work, the curricula which are followed, and the methods and character of the training. There is a brief review of the facilities in our own country for such instruction and comparison is made of their work with the work accomplished in Germany. In what follows, a summary is given only of certain sections of the paper and the reader is further referred to the complete pamphlet.

Four factors may be singled out as being responsible for the tendency toward sustained and thorough, yet specialized and practical, preparation for municipal service in Germany.

The first is the rapid rise in urban populations. Half of the German population are now urban residents. This enormous increase in urban populations means an increase in public functions assumed by city governments many times greater than the increase in population and requires efficiency and training of public employes.

Preparation for governmental positions in the state has been provided for in the state universities. These institutions are under the domination of practically the same group of officials that control the state administration. Thus, while state positions are amply prepared for, at least in certain of the universities, they do not tend to give the specialization and the emphasis upon municipal service demanded by urban needs, and a demand was created for local institutions that would offer the necessary training for municipal employes. This constitutes the second factor.

The burgomeister and the paid expert advisers in the magistrat were, as a rule, well trained at the state institutions. But no special training was provided for the great rank and file of city employes, the efficiency of whom, after all, decides the skill and utility with which the taxpayer's money is spent. The need for training well every municipal employe through inadequate preparation for positions, is the third factor.

The fourth factor is that public service is a recognized profession of dignity and permanence in tenure. The oft-repeated assertion that there is *no* politics in

[1] Wharton School of Finance and Commerce, Univ. of Pa.

Abstract of paper and discussion presented at the Annual Meeting, December 1914. Complete paper may be obtained without discussion; price 5 cents to members, 10 cents to non-members.

German city positions is far from accurate; but in Germany the provincialism characteristic of so many American cities, which brands experts from other cities or states as " outsiders " or " aliens," finds no place. The result is that a public employe with adequate qualifications, who finds himself blocked in one city because of his party affiliations, can look toward employment in other cities. A position once secured, a tenure for life or for a term of 12 or 24 years, is assured, followed by a pension at the end of service. Moreover, promotion is made from city to city so that there is no limit to the economic returns and social prestige of the public official of competence and skill. Even the burgomeister and all the leading expert advisers in the magistrat are chosen at will from other cities. The salary, moreover, is adequate to attract the best talent, and increases in remuneration follow at specific intervals. The national laws frequently provide that appointees to certain positions shall have stated professional qualifications, but all examinations are qualifying and not competitive. The result is freedom of choice by an employing official who must have the best talent and get the best results within his expenditures, for pressure of the tax is as keenly felt in German cities as in American cities.

The fifth factor is the fact that the great public utilities such as the street railways, gas and rail waterways, are publicly owned and operated. This means that not only the best paying positions but also the positions carrying with them social prestige and honor, are within the gift of the state rather than in the power of private corporations. The youth of capacity and training turns, therefore, by preference to the public service.

The technical training required for the municipal expert in Germany is usually afforded by some branch of the regular educational system.

In the great technical universities everywhere maintained by the individual states, technical training of the most definite and specific kind can be obtained for either public or private expert work. At the present time there are 11 great scientific universities, the organization of which is under the control of the several states of the German empire.

Below the highest technical institutions are two grades of machine trade or mechanical engineering schools, those providing for the training of engineers, constructors, foremen, machine draftsmen, etc., and those of a lower grade which train machinists, mechanical draftsmen and technical officials of middle rank and others preparing for positions that require a less highly developed technical ability. To both these classes of schools are often added Sunday and evening courses, open to workmen who cannot afford to give up work entirely and attend school.

Technical preparation for expert work in building trades can be secured in the fifty odd building-trades schools in Germany, most of them with two departments; architectural (Hochbau) and civil engineering (Tiefbau).

Technical preparation for the industrial arts can be secured in either one of the following groups of art trade schools: industrial continuation schools for the art classes; schools for hand-crafts; schools for industrial art and hand-crafts, and industrial art schools. Preparation for other special positions requiring technical preparation can be found in the continuation schools, in the textile schools, in the technical schools for woodworkers, in the commercial schools, many of which are also supported by the leading commercial and labor organizations of the country, in the modest classes conducted in winter evening hours by the light of the oil lamp in the low school room of the villages.

General school training, however, can not make the efficient employe; for this there must be scientific preparation and, in the case of employes and officials in municipal service, particular training. The author takes up a study of the general educational system for municipal employes, with a discussion of particular institutions, based on an extensive study of catalogues and announcements. Two examples only will be quoted in this abstract, the Akademie für kommunale Verwaltung zu Düsseldorf, and the Erste Preussische Verwaltungs-Seminar zu Aschersleben.

The purpose of the academy for municipal administration in Düsseldorf, opened for work in the autumn of 1911, is to strengthen and broaden the knowledge of and to offer a scientific and practical training to municipal officials, and to give business-like, scientific and practical education to persons intending to enter the municipal service. A survey of the courses offered and the methods employed indicates that the academy is primarily an institution for the further training of the higher municipal officials.

The academy is a municipal institution of the city of Düsseldorf, established by the city council. The teaching staff is composed of (*a*) official expert teachers, (*b*) expert teachers who offer lectures for each academic year, (*c*) honorary experts, who offer lectures for a specified time on unspecified subjects, (*d*) leading state and municipal officials, (*e*) scholars and (*f*) former professional men who are procured for certain discourses. While the academy is thus under municipal control and supported by municipal grants, it is subject to state supervision by the minister of ecclesiastical and educational affairs.

The courses offered include the following subjects: Constitutional rights; governmental rights; the police power; social questions; school and sanitary administration and legislation; insurance law; road law; economics; agricultural economy; political science; sociology; the resources of the country; national economy; the lawful rights of government; the organization of city, state and nation; efficiency in government; the science of finance; taxation law; money and bank-

ing; public works; the city's utilities; statistics; building regulations and administration; the cultivation of prosperity and of refinement; defense of the country; the labor question; relief of the poor; business law; practical work in administrative law; municipal finance and constitutional law; criminal law and procedure; the poor law; administrative law; labor union laws and their interpretation; criminology, hygiene and commercial and financial bookkeeping.

Selective courses are provided, such as one in the science of law which includes the foundation principles as to the rights of citizens and the rights of officials; purchases, leases, deeds and their characteristics; indemnity obligations of the community; earnings and laws of properties; real estate law, rights of mortgages, the authority of parents and the power of the respective governments as guardians; the rights of associations and of business; commercial law; the foundation principles as to state, rural and city administrative law; the constitution of the state of Prussia, the Imperial constitution, the rights of administrative organs of government, the police power and the general position of the police including the safety and sanitary police. There is a course in taxation, one in insurance law, statistics. Thorough-going courses are offered in national economy with special application to the protection of properties and the development of new industrial opportunities. Corrupt practices and efficiency in government are likewise taught as are the cultivation of prosperity in the different communities and the inculcation of the proper doctrines as to a national program for industrial supremacy. In the course germane to pure water for the city are given complete geological data.

Quite in contrast to the Düsseldorf academy, which trains primarily the higher officials, is the Professional Training School for Civil Service at Aschersleben which offers courses preparing primarily for the one year probationary service the middle and lower classes of public employes, and for promotion from a lower to a higher grade of service. The institution is administered by the magistrat of the city of Aschersleben and its stated purpose is "to give to young persons the general and professional education necessary to enter the public service career as a minor or middle officer." The course gives at the same time an opportunity to prepare for higher municipal adminstrative positions, such as mayors in smaller towns and the higher posts in the larger towns.

The duration of the general course is three years. The school also offers a one year special course for the training of minor civil service employes under governmental, provincial and administrative boards, as well as a one year continuation training course for minor municipal officials. It also provides a three months' continuation course for those in military service who may desire to prepare during compulsory army service for minor governmental positions.

The curriculum includes three general classes of subjects: (*a*) scientific courses such as German, mathematics, history, geography, French, English, chemistry and physics; (*b*) professional courses such as jurisprudence or general legal knowledge, constitutional and administrative law, social administration, political economy, public finances, the science of taxation, the budget and the treasury; and (*c*) applied courses such as typewriting, stenography, drawing, accounting, bookkeeping, arithmetic and German.

The instructors are employed teachers and the public officials of the city of Aschersleben. At the end of the one year, the tuition for which is 150 M., there is a final examination in the presence of a state examiner, the chief burgomeister of Aschersleben and invited members of the Central Alliance of Prussian officials on the basis of which a final graduation certificate is given.

This survey of what certain German institutions are doing leads to these definite conclusions: (*a*) While American universities are doing much, they are not offering the practical, definite preparation for public service that is being offered by certain German institutions; (*b*) that the courses of study offered and the plans for municipal colleges in Germany point to endless possibilities for adaptation in the courses and work being offered in American colleges and universities; (*c*) to the end that the public employe may be more adequately and efficiently trained, our colleges and universities can extend with profit to themselves and to the public, the number of definite, practical courses offered in their institutions; and (*d*) particular attention can and should be given to the preparation for special types of public service in certain of our educational institutions. One or two of the universities in the larger cities can prepare definitely for municipal service, others for the consular and diplomatic service, others for state service, others for service in departments of health and sanitation, while others can prepare experts in engineering, social, financial and accounting fields; and (*e*) there is a need in America for a few special institutions offering a specialized training of and for the public employee, who has had his technical preparation such as is given in the Academy for Public Administration at Düsseldorf and the Seminary for the Public Service at Aschersleben.

DISCUSSION

J. F. YOUNG,[1] in a written discussion, questioned whether courses in municipal subjects should be offered chiefly for the young college student or for the city employe. Hereto-

[1] Univ. of Penn., Phila.

fore we have taken for granted that the young college man was to be the source of our future supply of city experts.

We should work chiefly in the opposite direction, and should so arrange our courses that they will appeal to and help the man who is already active in city employment, or the practising engineer, who after having seen the problem from a point nearer its center, has decided that he wishes to devote himself to city work. Both these types of men are far more valuable for the purpose of providing and training an adequate supply of scientific technical city administrators and experts than the young college student.

A sharper distinction is needed between the general course on city government and the technical highly specialized course on sanitation, housing conditions and methods, city transit, labor, accounting, finance, etc. Thus far we have tried to cover all these fields and have therefore presented in a single course a group of studies which are too general for the technical student and too technical for the general student.

With the new attention to the subject which is now arising, we must have a clearer notion of the class of men and women who are to be trained; a relegation of the general courses to the field of general education of college undergraduates; and a more extensive development of the highly specialized technical subjects for smaller classes of professional men and women. This plan also involves a complete transfer of the technical work to the evening, in order that it may be pursued by those who are already engaged in engineering, municipal employment or other vocations.

Such a sharp distinction between courses, based on a clearer view of the clientele to which they are to appeal, would lead to a different development from that in Germany, but would answer more fully the distinctively American needs for the training of municipal servants.

J. A. Fairlie,[1] in a written discussion, stated that the professional schools in this country, in the state and private universities, are giving professional training in engineering, law and medicine, which offers special training for municipal service. In several states there are Associations of Municipal Officials which hold their meetings and carry on their work in coöperation with the state universities. It has been suggested that the university should offer a series of short courses, for a week or two, in municipal subjects, for city officials, similar to its short courses in agriculture.

There is undoubtedly need for further development. This will require the active coöperation of our educational institutions, public officials and the members of the several technical professions.

H. S. Gilbertson[2] wrote that there is an academic and practical reason why we have not developed a profession of public service. The academic reason is that there has been a fear on the part of a large number of political leaders that democracy would be endangered by a permanent and highly trained civil service; that we would drift into bureaucracy, and all that it entails. The practical reason is that another, and a very large element in political leadership, has desired to control appointments to public office for party reasons.

So long as this latter condition prevails, it is perfectly obvious that mere efficiency and fitness are minor considerations, and public service was repellent to men of high qualifications.

Present conditions afford much hope that both the academic and the practical objections to a trained civil service will gradually disappear.

Civil service reform also obviously favors the trained men. The merit system in the civil service was primarily devised as a method of eliminating politics and the most unfit applicants for public office in the lower grades of the service. But civil service reform is developing in new directions and is correcting some of its mistakes. There is a tendency to make records of efficiency the basis of promotion. This undoubtedly will favor not only a higher degree of preparation on the individual's entry into public service, but a certain standard of performance will be made the price of his remaining in the service. This should so dignify civil service that a higher type of men will be attracted to it.

Still another movement which will greatly favor a trained body of public servants is the application of the principle of the short ballot. When it is carried to its logical limits there will be a much sharper distinction made in the public mind between politics and administration.

There is coming to be a general recognition on the part of all intelligent people of the need for better trained public officials. People are beginning to see that when everything else is being subjected to high efficiency tests, government cannot much longer be run on the haphazard plan which has obtained in the past. Also there is the high cost of government. It is impossible to tell what we are paying for unnecessary and ill-performed public service. Senator Aldridge, some years ago, made the statement that $300,000,000 a year could be saved by the federal government.

Finally, we must consider the growing complexity of governmental functions. It is not simply that we are branching out in new fields, but that we are undertaking in a scientific way to perform old obligations. Police administration, for example, has become almost a science. In the field of corrections we are not content to have jail keepers, but we must have constructive sociologists who know something about the causes and remedies of crime. Likewise, public health administration no longer means stamping out epidemics, but it seeks to eliminate the conditions which may at any moment produce ill health.

Sanford E. Thompson said that in the problem of municipal work we must also consider the demand for municipally trained men. Until our cities realize the necessity for these men and there are more openings for them, there will be very little increase in the education to be offered. This situation, however, is improving, through the appointment of city managers and other steps tending toward the department of municipal work. He believed that the college alone does not offer the training that it should for this kind of work. The student must also have practical experience, and he had found the best men to employ to be those who have done practical work, worked their way through college or done special work in the summer.

[1] Univ. of Ill., Urbana, Ill.

[2] Exec. Secy., The Natl. Short Ballot Organization.

A STUDY OF CLEANING FILTER SANDS WITH NO OPPORTUNITY FOR BONUS PAYMENTS

BY SANFORD E. THOMPSON, NEWTON HIGHLANDS, MASS.

Member of the Society

Efficiency in municipal government will come about only as the work in the various departments is put on a basis which gives each man, from the common laborer up to the skilled artisan and clerk, a well-defined task to do in a given time, with a definite reward for its accomplishment. Under the ordinary methods of handling city work it is cheaper where there is fair competition to let work by contract than to handle it by day labor. With an effective system that eliminates not merely favoritism but also presents a definite incentive for each man to do a fair day's work, a city may save the contractor's profit, employ its own force of city men, and avoid one of the largest sources for mulching a city treasury through collusion between the city officials and contractors.

The construction and maintenance work in the department of public works is a field that offers the largest opportunities from an engineering standpoint. It includes such operations as trenching, pipe-laying, sewer construction, aqueduct construction, filter cleaning, street cleaning, road building, grading, concrete work, and building construction. All of these can be handled by scientific methods.

In the present paper one of the accomplishments of the City of Philadelphia along the line of improved methods is described, viz., the cleaning of filter sand, one of the operations in the Bureau of Water of the Department of Public Works, which is in charge of Mr. Carleton E. Davis, Chief of the Bureau, and under the supervision of Mr. Morris L. Cooke, Director of Public Works.

Results Accomplished. The object of the plan has been to lay out the work of each gang of men so as to increase the effectiveness of the plant and provide a definite task to be accomplished in a day.

The results of the plan which is being put into operation are as follows:

Rotation of cleaning the filters is planned in advance by well defined rule.

A definite area of sand to clean is assigned to each gang, this area depending upon the depth of cleaning necessary.

This setting of tasks has increased output of each gang 15 per cent and this should be further increased to at least 25 per cent.

Accurate records are kept, showing the time consumed by each gang.

Cost accounts, as well as pay-roll, are made up from the time tickets furnished to the men.

Gang leaders are required to pay closer attention to their duties.

Improved apparatus and machinery are under consideration.

Methods of determining depths of sand to clean are being standardized.

Obstacles Encountered. The paper contains an account of the methods introduced to secure these results. As indicated in the title of the paper the Philadelphia ordinances prevent the payment of a bonus and thus make it difficult to encourage the men to accomplish the tasks assigned to them. The city fixes the rate of pay of unskilled laborers on a level wage per day regardless of the quality of the workman or the amount of work he can do. Civil service regulation, which prevents the discharge of a man for political reasons, also limits the power of discharge for inefficiency. Although the fear of discharge affords a crude means for obtaining a fair day's work, its elimination, with no opportunity for providing a substitute increases the difficulties. The handling of the work would have been much simplified if it had been possible to provide, for a man well fitted to his work, a reward for accomplishing a good day's task.

At the beginning, the general attitude of the men and the foremen was antagonistic, as is almost always the case where new methods are being introduced. This is gradually overcome as the results become evident.

Method of Attack. The method of attacking any problem in order to place it on a scientific basis varies with the character of the work. In certain cases, such as intricate factory operations, it is necessary, before any tasks are set or even before time studies are made, to establish a complete system of routing the materials and the employes. In other cases the first necessity is to establish standards, making minute investigation of the processes. In still other cases time studies can be made at the start.

In the sand cleaning proposition all of these methods were carried on in a measure simultaneously. Studies were made of the men and the methods employed to see where the manner of handling the work could be improved. Time studies were made to determine the unit times for each individual operation, so that the tasks could be figured accurately in advance. From records already on file, giving the approximate time for cleaning, it was possible to begin the organization of the routing system.

Unit Times. The unit times for the individual operations were determined by the taking of a large number of time studies in such a way as to eliminate all unnecessary delays, but with a sufficient allowance

Abstract of paper and discussion presented at the Annual Meeting, December, 1914. Complete paper may be obtained without discussion, price 5 cents to members; 10 cents to non-members.

for resting and delays which were unavoidable. The unit times obtained are given in Table 1.

TABLE I UNIT TIMES

Operation	Unit Time per Operation Min.	Time per Cu.-Yd. per 1-in. Depth Min.
Moving hopper	0.20	0.34
Moving separator	0.50	0.45
Moving hopper hose	0.25	0.11
Moving track	0.83	0.44
Waiting for hopper to empty	0.42	0.38
Moving pressure hose	1.80	0.36
Additional necessary rest	....	0.12
Shoveling to hopper	....	6.32

The time given in each case is that for the gang, since it was necessary on this work to set a task for the entire gang instead of starting the individual men, as it is always best to do when possible. The time of shoveling into the hopper is in each case based on the rate of output that the ejectors will take care of. It was found that one man, instead of two, could very nearly produce the required output, but this would have lengthened the time of cleaning so as to be inadvisable. For example, with one man shoveling, the shoveling time per cu. yd. is 8.8 minutes with a 1-in. depth, and 6.75 minutes per cu. yd. when the depth is 18 in. These studies indicate therefore that further change is necessary in the method of operation so as to increase the output of the injector and separator in order to obtain the full value of the labor of the gang.

Routing. The routing was accomplished by the aid of a bulletin board of the type used in the Taylor system provided with suitable hooks for the tickets which designated the work of each man. One of the lines of books held tickets indicating "Work to be done NOT READY"; a second line above it, "Work to be done READY"; and the third line, above this "WORK IN PROGRESS." On these tickets, there is space for all the information required.

Setting Tasks. Having determined the unit times and established the system of routing and giving out of tickets, the area of surface that should be shoveled by each gang was figured and the point to which they were supposed to go in a day's work was marked with a flag. Curves have been plotted, giving distances to clean for the outside and inside gangs for various depths.

On the first two days, after everything was ready, no instructions were given the gang leader or the men as to how much they were expected to do. The total area shoveled by each gang, however, was noted, and compared with the area they should have accomplished. Every gang shoveled less than the figured area, the amount running from 10½ per cent less to 31½ per cent less. After this second day's work we concentrated on one gang, and laid out in advance the amount they should accomplish in a day. As a result, they readily accomplished the task and reached the mark. The task setting was then extended to other gangs.

An interesting point came up in connection with the handling of the work at first. The men in the outside bays had to shovel about 7 per cent more sand than those in the inside bays because the areas were wider; nevertheless, all gangs had been accustomed to keep abreast, the men who had the narrower width to handle slowing up to accommodate their speed to the outside men. When the men began working by the task, the inside men, because of the narrower width, were given the longer area to cover and gaged their speed to accomplish their task. The outside men, although shoveling a greater width kept abreast with them without special trouble, thus exceeding their task.

DISCUSSION

CARLETON E. DAVIS[1] contributed a discussion in which was additional information upon the operation of the Philadelphia filters. A few quotations follow:

The labor cost of operating the filters of the Philadelphia water supply is about $175,000 per year. The result of Mr. Thompson's work as maintained up to the present time is to increase by about 15 per cent the output of the force employed upon cleaning sand in the final filters. This phase of the filter operation represents perhaps 90 per cent of the total labor cost of running the plants. This pick-up is very gratifying to all concerned and the author may well feel pleased that he has accomplished so much in the face of adverse circumstances.

Mr. Thompson's studies have developed a marked advance in the organization of the force and the handling of problems connected therewith. They have not, however, changed the fundamental characteristics of the filtration factors of the plant, nor have any new underlying principles been discovered. This should be clearly understood and the statement that rotation of cleaning filters is planned in advance by a well defined rule should be interpreted accordingly. The planning is done in advance as far as possible, as is the case in all well organized filter plants, but no new rule has been discovered or developed whereby each filter can be assigned to a fixed position in a prearranged cleaning schedule.

The Delaware River from which the Torresdale filters take their water is affected by storms and other weather conditions, by seasonal changes, by temperature variations, by tides, and even by navigation in the stream. A sudden or unexpected storm or any one of a number of other phenomena may upset any prediction as to the exact day when a particular filter should be cleaned.

The sand cleaning groups are now working at increased speed and with less lost time caused by errors or false motions on the part of the foremen. Certain factors stand out more prominently than others in having produced these results. Defining in advance what shall constitute a day's work, clear and easily understood general orders, and the toning up of the organization whereby each man is more

[1] Chief Bureau of Water, Philadelphia.

or less on his mettle, appear to be the features productive of the most good.

Time studies were instrumental in determining what is a fair day's work. Experience showed that better results were obtained by clearly marking the limits of each hour's work rather than depending upon a single mark defining the end of a whole day's work. The more frequent goals aid the judgment of the foremen and stimulate the efforts of the men.

General standing orders containing explicit and readily interpreted instructions about each feature of the work are issued to all foremen. These orders place before each man an outline of his duties and take away the excuse of ignorance or misunderstanding.

THE AUTHOR in closing said that he did not agree with Mr. Davis in his idea that the arrangement of the cleaning cannot be designated very distinctly in advance. Studies have been made to a certain extent on the general operation of filters at different plants, with a view of going into this matter but a continuation of study in this line is bound to result in a possibility of planning the different features very definitely and reaching the fundamental conditions which do not appear on the surface.

THE DESIGN AND OPERATION OF THE CLEVELAND MUNICIPAL ELECTRIC LIGHT PLANT

BY FREDERICK W. BALLARD, CLEVELAND, O.

Member of the Society

The new municipal lighting station on East 53rd street, Cleveland, Ohio, went into operation July 20, 1914. It is the largest central station to be built by a municipality in this country, and is intended not only to supply electric current for street and commercial lighting, but also for power users. The rates which are being charged for service range from $0.03 per kw-hr. maximum to $0.01 per kw-hr. minimum. This station has a capacity of 25,000 kw. and is at present loaded to one-fifth of its capacity.

The decision to build this plant by the city of Cleveland was the result of experience with a small station of 1500-kw. capacity, known as the Brooklyn Station, which has been in operation by the city since 1906. It had been started by a bond issue of $30,000 and had by appropriations amounting in all to $211,649.22, together with additions to its plant from profits and earnings, grown to a total investment in plant value of $548,182.43. It had thus made the remarkable record of having acquired more than one-half of its total value in eight years from the earnings of the plant itself. Table 1 is a condensed statement of the financial record and Tables 2, 3 and 4 of the revenue and expense from this station.

Abstract of paper and discussion presented at the Annual Meeting, December 1914. Complete paper may be obtained without discussion, price 10 cents to members: 20 cents to non-members.

TABLE 1 PLANT VALUE OF BROOKLYN STATION AND DISTRIBUTION SYSTEM

Bond issue 1902		$30,000.00
From taxes and general fund	$320,796.24	
Value of street lighting	109,147.02	
Added to plant value from taxes and general fund 1906–1909		211,649.22
Added from earnings		306,533.21
INVESTMENT IN PLANT, DEC. 31 1913		548,182,43
Depreciation written off Dec. 31, 1913		113,244.19
DEPRECIATED VALUE OF STATION Dec. 31,		$434,938.24

TABLE 2 REVENUE AND EXPENSE STATEMENT FOR YEAR 1913

TOTAL REVENUE FROM SALE OF CURRENT			$185,698.81
Kw-hr. generated	7,797,661	Average sale price $0.0238	
Kw-hr. sold	5,656,668	Average sale price 0.0328	
TOTAL OPERATION AND MAINTENANCE EXPENSE			116,719.55
Kw-hr. generated	7,797,661	Average cost price $0.0149	
Kw-hr. sold	5,656,668	Average cost price 0.0206	
NET EARNINGS			68,979.26
FIXED CHARGES—DEPRECIATION AND INTEREST			19,079.50
Kw-hr. generated	7,797,661	Average cost price $0.0024	
Kw-hr. sold	5,656,668	Average cost price 0.0033	
PROFIT FOR YEAR OF 1913			$49,899.76

TABLE 3 POWER STATION REPORT FOR YEAR 1913

OPERATION		UNIT COST
Labor	$23,050.25	$0.0029
Oil, packing and waste	1,538.52	
Water	3,110.00	
Sundry expense	743.32	0.0007
Coal	39,275.42	0.005
MAINTENANCE		
Buildings	$105.85	
Boilers	3,515.98	
Engines and generators	3,449.72	
Condensors and piping	606.91	
Switchboard	153.48	
Tools	223.81	
Arc light equipment	661.88	
Sundry repairs	246.21	0.0011
TOTAL OPERATION AND MAINTENANCE	$76,681.35	0.0097
Total kw-hr. generated	7,797,661	

TABLE 4 DISTRIBUTION SYSTEM—OPERATION AND MAINTENANCE FOR YEARS 1912–1913

	1912	1913
Poles and lines	$7,342.53	$8,203.32
Arc lamps	2,241.68	4,485.53
Meters	334.12	486.68
Tools	197.25	213.69
Wagons, harness, etc	582.16	760.28
Stable expense, feed, etc	1,134.86	1,935.57
Carbons and globes	2,219.08	2,735.80
Trimming labor	2,811.25	2,437.48
Services, transformers, etc	3,224.87	6,166.62
Miscellaneous expense	573.40	1,084.94
Auto truck	......	923.61
Substation maintenance	......	2,054.98
	$20,661.20	$31,846.50
Kw-hr. generated	4,611,853	7,797,661
Cost per kw-hr. generated	$0.00448	$0.00408

A close analysis of the figures in the tables shows that in many cases these costs could be greatly reduced by the operation of a system on a large scale, and by the efficiencies which will be obtained in the new power station. The item of cost in central station work which has usually been considered the most uncertain and problematical, and therefore most likely to stand in the way of success for manicipalities, is the cost of distribution. The costs for operation and maintenance of the distribution system connected with the Brooklyn Lighting Station in Cleveland, becomes, therefore, of particular interest, and the itemized costs set forth in Table 4 establishes a certain definite value for this feature.

PRELIMINARY ESTIMATES FOR THE NEW STATION

The estimated results which will be secured from the new 25,000-kw. station which has just been placed in operation, are based upon an annual output of 60,000,000 kw-hr., and with fixed charges based upon a total plant investment of $3,000,000.00. Fixed charges amounting to 9 per cent on this investment would equal $0.0045 per kw-hr. Cost for coal is estimated at $0.002 per kw-hr. Station costs exclusive of coal at $0.0015. Distribution costs, exclusive of fixed charges at $0.004. Administration charges at $0.0005 and profits at 8 per cent on the investment at $0.004. This makes an average price to be secured per kw-hr. generated of $0.0165. From the three months' operation of this station, together with tests that have been conducted the indications are that these estimated results will be secured.

In explanation of these figures, the author says that it would be conservative to allow for an average interest rate of 4½ per cent on the whole investment of $3,000,000. The tax rate can be conservatively estimated at 1½ per cent, and the rate to be allowed for a reserve fund for depreciation, or what really would better be known as an amortization fund, since depreciation, obsolescence, etc., will be taken care of from the maintenance fund. The amortization fund should be taken care of by a rate of 3 per cent, this rate for use as a conservative allowance, because 2.92 per cent of the original cost invested annually at 4 per cent compound interest will equal the original investment in 22 years. These rates for interest, taxes and depreciation call for an annual allowance to cover fixed charges of 9 per cent of the original investment.

In order to arrive at the estimated unit cost for the fixed charges, it was necessary to assume a certain total output for the station for a year. A 40 per cent load factor is generally considered very good in central station work. There is no question, however, but that under good conditions a load factor much better than this can be secured. Assuming a 40 per cent load factor in a peak load of 18,000 kw. would give a total output a year of approximately 60,000,000 kw-hr. Fixed charges for the entire plant investment of $3,000,000 rated at 9 per cent would amount to $270,000 per year, and on the basis of a 60,000,000 kw-hr. output the cost per kw-hr. to cover fixed charges would be $0.0045 or $0.0015 for the station cost and $0.003 for the distribution cost.

Other items to be decided upon are unit costs for coal, labor, maintenance and sundries; expense for operation and maintenance of the distribution system; and administration charges. The value of $0.0005 for the last item was based on the known cost in connection with the Brooklyn Station. In order to be fair in making a comparison with privately owned and operated plants, an allowance was made for profit of 8 per cent, or $0.004 per kw-hr., as mentioned above. The several unit costs are given in Table 5.

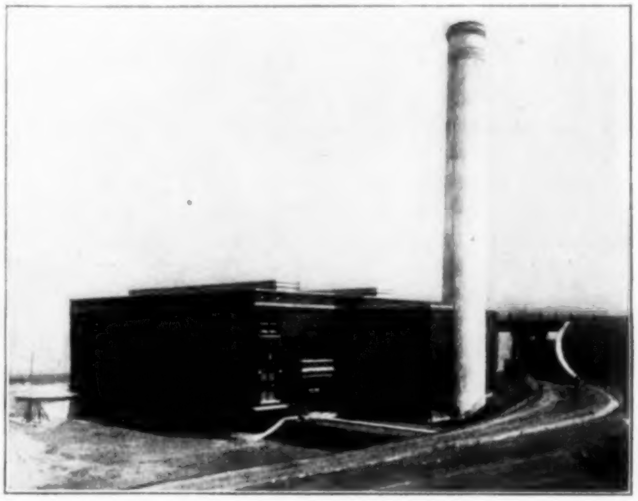


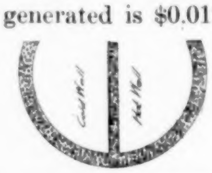
Fig. 1 Exterior View of the Cleveland Municipal Lighting Plant

TABLE 5 ESTIMATE ON UNIT COSTS FOR EAST 53RD STREET STATION

Station Costs	Cost per kw-hr.
Coal	$0.002
Labor, maintenence and sundries	0.0015
Fixed charges	0.0015
Total station costs	0.005
Distribution Costs	
Operation and maintenance	0.004
Fixed charges	0.003
Total distribution costs	0.007
Administration Charges	
Administration charges	0.0005
Total amount cost	0.0125
Profit required	0.004
Average sale price required per kw-hr. generated	0.0165
Estimated kw-hr. to be generated	60,000,000

RESULTS OBTAINED

The results which have already been obtained in the operation of the Brooklyn Lighting station and the East 53rd Street station during the first eight months of the year 1914, tend to substantiate the original estimates of what will eventually be secured in connection with the operation of the East 53rd Street station. Following is the statement of revenue and expense connected with the operation of these two stations for the first eight months of this year:



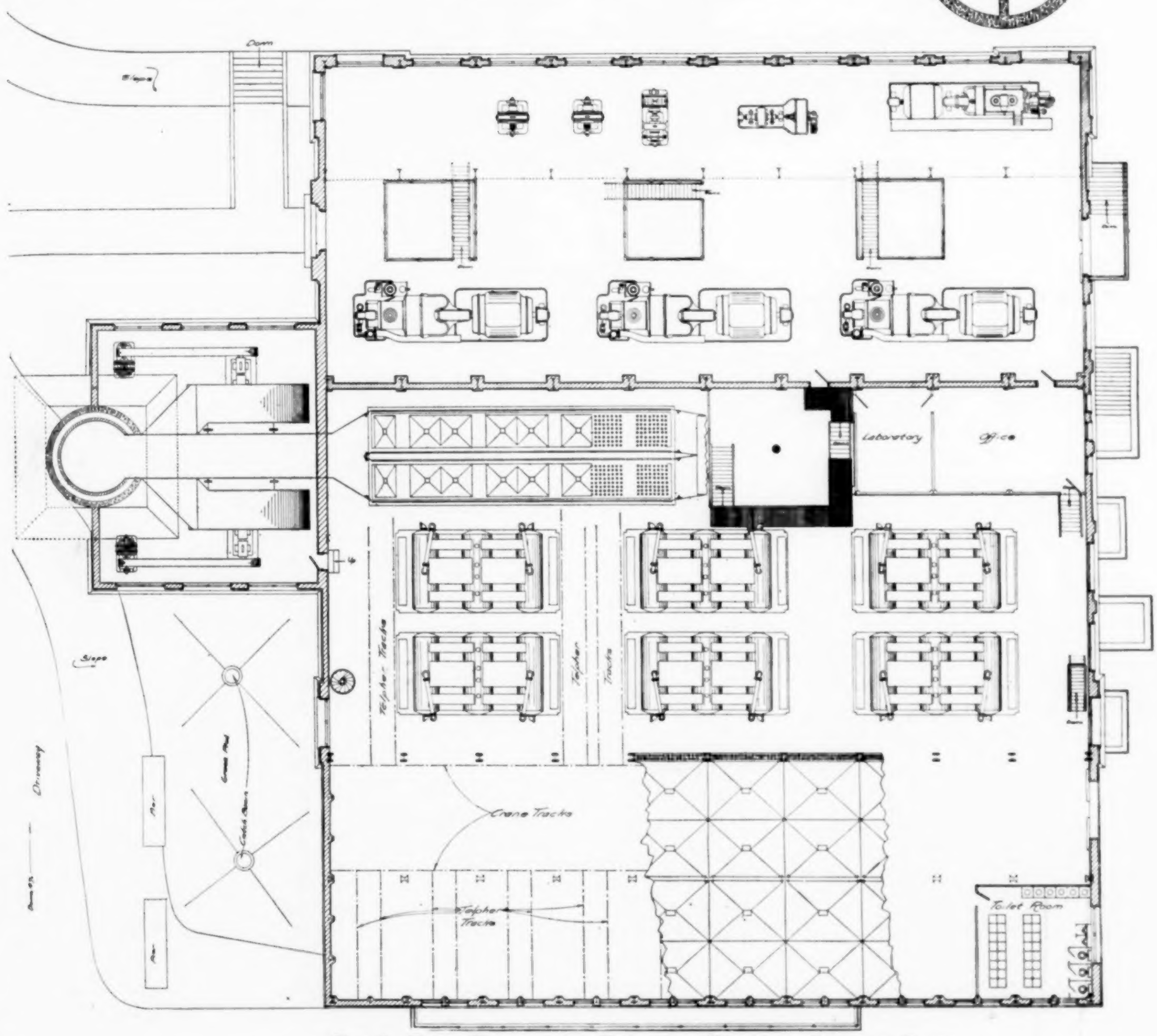


FIG. 2 FLOOR PLAN OF THE CLEVELAND MUNICIPAL LIGHTING PLANT

REVENUE AND EXPENSE STATEMENT FOR FIRST EIGHT MONTHS 1914

Revenue from sale of current for first 8 months of 1914.		$153,363.65
Kw-hr. generated.... 7,863,610	Average sale price. $0.0195	
Kw-hr. sold. 6,270,726	Average sale price. 0.0244	
Operating and maintenance for first 8 months...		$97,044.60
Kw-hr. generated.... 7,863,610	Average cost price. $0.0123	
Kw-hr. sold. 6,270,726	Average cost price. 0.0154	
Net earnings for 8 months........................		$56,319.05

The total kw-hr. generated for eight months is greater than the output for the entire year of 1913. The average cost price per kw-hr. generated is $0.0123 as compared with $0.0149 for the previous year.

The East 53rd Street station has been in operation since July 20, 1914. The results secured in the way of operation and maintenance costs in the power station itself for the month of August and September are shown in Table 5.

TABLE 5 EAST 53RD STREET POWER STATION REPORT, AUGUST AND SEPTEMBER, 1914

OPERATION	August	Unit Cost	September	Unit Cost
Labor..........................	$1,498.48	$0.0018	$1,573.00	$0.0017
Switchboard attendance..........	352.80	0.0004	380.00	0.00042
Oil, packing and waste...........	...	...	66.89	0.00008
Sundry expense.................	...	...	10.46	
Coal...........................	2,686.50	0.0033	2,415.69	0.0026
MAINTENANCE				
Condensers, piping, etc...........	5.48	...	...	...
Total operation and maintenance	$4,543.26	$0.0056	$4,446.04	$0.0048
Total kw-hr. generated.........	809,120	...	914,850	...

The East 53rd Street station during these two months has been operating at less than one-fifth of its total capacity. The figures representing unit costs for the various items of labor, maintenance, fuel, etc., are, of course, considerably higher than can be obtained when the station is running up to its capacity, when it will be operating at a much higher efficiency in regard to coal consumption per kw-hr., and also the labor and other charges will be less per unit cost by reason of the larger output. During the month of August, the output of the Brooklyn and East 53rd Street stations amounted to 1,117,920 kw-hr., of which 936,467 kw-hr. were actually sold to customers, giving a loss in transmission of only 16¼ per cent, the average sale price for the kw-hr., generated being $0.0174 while the average sale price of what was actually sold was $0.0207; the revenue for the month being $19,405.38. The author states that an average load factor of 40 per cent on this station when the load is built up to its ultimate capacity seems to be assured, and in fact that a better load factor than this will actually be obtained. Prices charged for current for power purposes ranging from $0.3 down to a minimum of $0.01 become particularly attractive to factories, who are able to supply those conditions necessary for a good load factor, as is attested by the load factor which has already been secured on this station. A typical load curve is shown in Fig. 4. In this curve the peak load is shown to be only 2700 kw., but with a load factor of 80 per cent based on the peak load, there is a total output on the generating station of 51,925 kw-hr. If these conditions can be maintained, or even approximated, when the load on the station has been built up to its ultimate capacity, the load factor will be considerably greater than 40 per cent.

Fig. 3 Switchboard and 11,000-volt Compartment for Supplying Business District

EQUIPMENT OF STATION

The new plant has a maximum capacity of 25,000 kw. The special features in connection with the design of this station which are different from standard practice, are as follows: The use of motor-driven auxiliaries exclusively throughout the plant; the use of large boiler units with high steam pressure; the use of economizers of much greater capacity than ordinarily installed; a new arrangement of coal handling apparatus; the use of both forced and induced draft with practically atmospheric pressure in the combustion chamber; the automatic control of furnace conditions; the simplicity of the piping layout, due to motor-driven auxiliaries; and the use of an auxiliary steam turbine for driving the auxiliary motors. This turbine is supplied with a jet condenser, whose cooling water is the boiled feedwater before going to the economizers.

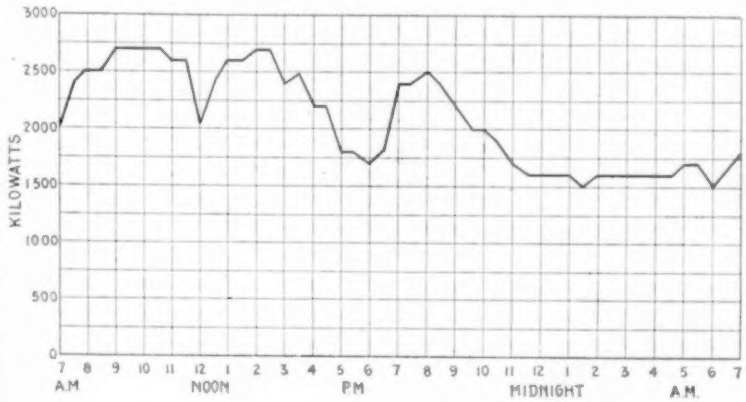


Fig. 4 Typical Load Curve, East 53rd Street Station

The large boiler units are quite similar to those in the Delray Station of the Detroit Edison Company, which have been described in great detail by D. S. Jacobus, in the Transactions of this Society.[1] The dimensions are identical with those of the Detroit boilers, except the length of the drums. These boilers are installed with 10,000 sq. ft. of heating surface each, and are designed to carry 275-lb. working pressure with a superheat ranging from 125 to 150 deg. fahr. They are equipped with Taylor underfed stokers, and are intended to be capable of operating up to 300 per cent of rating.

The operation of the boilers at a high percentage of rating means a higher temperature of flue gases. This, with the low temperature of feedwater, gives a temperature head between flue gases and feedwater which will be practically double that ordinarily obtained in economizer practice. This alone would be sufficient to warrant the installation of a larger amount of economizer heating surface. Another factor, however, is the low interest rate of 4½ per cent on the investment to be balanced against the saving produced in the economizers. These were installed by the Green

[1] Trans. A. S. M. E., vol. 33, p. 565.

Fuel Economizer Company and have a heating surface of 27,000 sq. ft.

The use of both forced and induced draught contributes greatly to the flexibility of the installation, and makes it possible to carry practically a balanced pressure in the combustion chamber, thus avoiding one of the greatest sources of loss in boiler practice, namely, the leakage of air through the boiler settings.

The turbine equipment consists of three units of Allis-Chambers-Parsons type, rated at 5000 kw. each, 1800 r.p.m., 11,000 volts, A.C., steam to be supplied at 225 lb. per sq. in. gage pressure, and 125 deg. fahr. superheat. The equipment of surface condensers was furnished by the C. H. Wheeler Company of Philadelphia. The power for the motor-driven auxiliaries is taken from a 1000 kw. turbine formerly in operation at the Brooklyn station, and will be operated in connection with a Le Blanc condenser, the cooling water for which will be drawn from a cistern used for the storage of the boiler feed water and which takes also the condensate from the three main turbines. The water in the cistern passes through the jet condenser several times before it goes as feedwater to the boilers and the connections are so arranged that the coldest water is supplied to the condenser and the hottest to the boiler feed system. The auxiliary motors in the station are connected through a double bus system so that each can be operated by current either from the auxiliary turbine or the main turbine. In this way the load on the auxiliary turbine can be adjusted so that the temperature of the feed water will be that best suited for delivery to the economizers.

Perhaps the most important innovation in connection with the operation of this station is not in the station itself. In central station practice in large cities it seems to have become a fixed rule to supply the conjested districts with direct current through 220-volt 3-wire Edison systems, resulting in an enormous investment in copper, a much greater loss in transmission at the low voltages and also the loss of from 15 per cent to 20 per cent in transformation from alternating to direct current in the substations; and with the additional necessity of a greater number of substations than would be required for alternating current distribution.

It is a fact that nearly all lighting and power requirements can be met in the congested districts with alternating current as well as with direct current. There are, however, a few cases where the requirements can be met better with direct current but these constitute a very small percentage of the total. In power work there are places where finer gradations of speed control than can be secured with alternating current are desirable, and in lighting work there are places where storage batteries are necessary to provide an absolute security against interruption of service. But in such cases it would be much more economical to take care of the requirements on the premises of the customer and install there the necessary converters, accumulators, etc. The cost of this would be represented by thousands, whereas the investment necessary for the transmission of low voltage direct current from substations runs into millions of dollars.

In Fig. 3 is shown the arrangement of the 11,000-volt compartments and switchboard of the East 11th Street Station, which supplies the "down town," or the business district of Cleveland. The simplicity of the station and the absence of rotary converters is particularly notable when compared with the prevailing practice of supplying the congested districts of large cities from numerous substations in which are installed large numbers of rotary converters for changing alternating into direct current.

DISCUSSION

ROBERT L. BRUNET, in a contributed discussion, expressed approval of the method of operating the auxiliaries in the Cleveland plant. The objection to motor-driven units has been uncertainty of operation, which is removed by the single steam-driven unit which in this plant supplies power to the auxiliaries. He approved, also, of the use of both forced and induced draught in order to maintain a balanced pressure in the furnace.

As the author stated, the most important change in connection with the operation of the station is the use of alternating current for the congested business districts, instead of the Edison three-wire system. He knew personally of engineers of large central stations who find that there are practically no customers who cannot be properly and adequately served with A.C. as well as with D.C. current; and where the latter is absolutely essential, the transformation from A.C. to D.C. can be made on the customer's premises more economically than otherwise. There are important arguments against the use of D.C. current if high-voltage A.C. current can be supplied instead.

With low rates for current, both for lighting and power, it seems only fair to state that the load factor of 40 per cent will possibly be realized, based on a peak of 18,000 kw.; but when the peak is reached, the generating equipment will undoubtedly have to be increased in order to insure reliability and continuity of service. The load factor itself is dependent upon the diversity factor, i.e. the ratio of the sum of the separate maxima to the total co-incident maxima. In some stations where the load factor is in the neighborhood of from thirty to forty per cent, the diversity factor will be from 2 to 3 per cent—dependent primarily upon the means employed by the central station to obtain additional load.

The ratio of current sold for power to total power generated in modern stations varies from 50 per cent to seventy-five per cent and without this power business the rates for lighting would be decidedly increased to the small consumer. Engineers should not forget that a diversity factor in a station is the basis of profit and should receive the utmost consideration.

In making a study of the income of various central stations the writer has found that the income per dollar of investment varies in most private plants from 20 to 25 per

cent. Mr. Ballard has estimated an income of 33 per cent per dollar of investment. This seemed high to the writer, who thought it would be somewhat reduced by the fact that when the maximum of 18,000 kw. was reached the distribution system would be so extended that the actual investment would be greater than the figure used at this time.

The writer had prepared charts (not given herewith) showing the disposition of each dollar of income for a large private station and the estimated disposition of each dollar of income for the Cleveland municipal station. The private station has a capacity of approximately 350,000 h.p., with a total output of 840,000,000 kw-hr. per annum. The Cleveland plant has an estimated output of 60,000,000 kw-hr. per annum. In order to afford a close comparison the figures are tabulated below:

	Private Central Station, per cent.	Cleveland Municipal Station, per cent.
Labor	17	
Materials, etc	23	
Surplus	7	
	47	36.40
Dividends	15	24.20
Interest	9	13.63
Depreciation	11	9.10
Taxes and Municipal Compensation	7	4.55
Fuel	11	12.12
	100	100.00

J. R. Cravath, in a written discussion, called attention to one of the features brought out by this paper regarding the low cost of modern steam turbine plants as compared with turbine or engine plants of like capacity a few years ago. A cost of $100 to $150 per kilowatt of maximum capacity was common in large city stations until very recently. The decreasing cost of steam turbine units per kilowatt and the increasing steam output to which boilers of a given capacity are being forced in common practice, together with the small ground space taken up by large turbine units per kilowatt, have combined to lower power station costs. A short time ago costs of $70 per kw. of station capacity were common for large steam turbine stations. In the present station, according to Mr. Ballard's figures, the cost of the station is about $1,000,000, which for a maximum capacity of 25,000 kw. corresponds to $40 per kw. On the basis of an 18,000 kw. peak load the cost is $56 per kw.

Figures given as to investment and operating costs correspond with estimates made by the writer on a station of similar capacity intended to operate under conditions of rather high load factor. The thermal efficiency which is assumed by Mr. Ballard is about 11 per cent. This corresponds to modern good practice in actual working conditions with the station fairly loaded. This efficiency in the best and largest modern turbine stations ranges from 10 to 13 per cent. The unusual method used in the supplying of good condensing water is in part responsible for the low cost of the plant per kilowatt.

Whether the estimated maximum load of 18,000 kw. can be brought to the station under conditions existing in Cleveland with a distribution system cost sufficiently low to bring the total investment to only $3,000,000 remains to be demonstrated. The cost of a central distribution system depends upon the character and distribution of the load. If the station can be fully loaded with a distribution system covering a small area and serving mainly large power consumers, the cost may be under that given. If the distribution system is to cover a large city where the load density is necessarily low because of dividing the business with a competing central station, existing experience indicates that it is very doubtful whether the station can be loaded to 18,000 kw. with a total investment of $3,000,000. The value of the power station being $1,000,000 leaves $2,000,000 for distribution system. With 18,000 kw. maximum load this corresponds to a cost of $111 per kw. for distribution system. On a similar basis the cost of the entire plant would be $167 per kw. of maximum load. It is probably not correct to take the cost of the Brooklyn system as a criterion of the cost of the 53rd Street plant with the distribution system when completed, but it is interesting to note that the Brooklyn system complete on a 1500 kw. capacity costs $365 per kw. of station capacity. If the station is not fully loaded the cost per kw. of maximum load would be higher than this. If we assume that the Brooklyn station alone cost $100 per kw. we would have $265 per kw. maximum load for distribution system investment. Distribution costs, in general, run from $100 to $300 per kw. As before explained, their costs will depend very much on the load and the size of the consumers. A large number of small consumers greatly increases the investment per kilowatt in distribution systems.

As Mr. Ballard points out, the economy of production is much dependent upon the attainment of a high load factor. A number of years ago, load factors of 20 to 25 per cent (annual) were common. This has gradually been brought up by the acquisition of additional power loads and in some cases by taking on street railway loads. A load factor of 35 per cent (annual) is high for a station supplying electric light and power alone and stations obtaining 40 per cent have done so usually at the expense of many years of strenuous work. It is possible that by cultivating the large power business and ignoring the low load factor lighting business a 40 per cent load factor might be maintained from the start in an enterprise like that at Cleveland. It must not be thought, however, that such a load factor represents an easy attainment. The natural tendency of such a rate would be to load up the plant with low load factor business unless great care were exercised to prevent it. We thus see the importance of the fundamental principle that the rates charged must bear some proportion to the actual cost of serving these classes of consumers.

In order to put this undertaking on a fair basis for comparison with a private corporation, 8 per cent is added for profit. In allowing 8 per cent profit in addition to 4.5 per cent interest, Mr. Ballard has apparently inadvertantly allowed considerable more annual return on the investment than would be necessary to clear him of a possible charge of unfairness to private corporations. Where commissions have passed on the question of reasonable return upon the investment in a plant of this character, the total annual returns, including both interest and profit, have been in the neighborhood of 8 per cent rather than 8 per cent in addition to interest. Mr. Ballard's fixed charges therefore should be reduced 4.5 per cent.

Fixed charges, depreciation and interest on the Brooklyn

plant with an investment of $548,182 is given as $19,079. This is only 3.6 per cent on the investment and appears to be an error. From the information given in the discussion, the depreciation on the Brooklyn plant would be considerably higher than for the 53rd Street plant inasmuch as a part of the Brooklyn plant investment would be written off as it is replaced by the 53rd Street station.

Depreciation on the complete plant is assumed at 3 per cent, calling for an average life of plant of 22 years. It is doubtful whether this is a sufficient allowance for depreciation even though it may be in accord with the customs of some private corporations. In the Madison Gas and Electric Co. case before the Wisconsin Railroad & Public Service Commission in 1910, the commission decided that the average life of the electric plant was about 17 years.

One element of first cost which can only be determined after the undertaking has reached the state of development anticipated in the preliminary estimates is that classified by the Wisconsin Commission as going value. Under this head is included whatever loss in operation is incurred in the early years of operation before the load has been built up to a point to yield a proper interest and profit on the investment. This amount must needs be added to the tangible physical investment to determine the total money put into the property.

Walter C. Allen wrote that the paper omits a description of one of the features most interesting to electrical men, viz.: the distribution system. Apparently the new 53rd Street station is delivering its energy to the existing distribution system through the East 11th Street sub-station, without the use of rotary converters.

The loss in distribution from the Brooklyn station for the year 1913 as given is 27.4 per cent, while the loss for the first eight months of the present year, with the 53rd Street station operating with it during the last six weeks of that period, is 20.2 per cent. The loss during the month of August with both stations operating, is given as 16.25 per cent. In the absence of any further information regarding improvements in the distribution system, the reader must assume that this increased efficiency is brought about by the use of alternating current in the low tension system, instead of direct current through rotary converters.

It will be interesting to see what further efficiencies are obtained from the new distribution system, for which it appears $1,500,000 is available.

Alex. Dow said that he had followed the construction of the Cleveland plant with a great deal of interest. It is in a neighboring town, the consulting engineer is an old friend, the plant is a good one and a credit to the author. There is, however, much in the paper that is speculative. He hoped that at a later time when the proof of the performance of the plant was completed, the results, whatever they might be, would again be placed before the Society. At present, there is lacking a distributing system for the plant, there is lacking a load, and accounts kept in a manner which would be acceptable to a Public Service Commission. When these are realized we shall know the answer to the question of what the plant is accomplishing.

He further called attention to the author's statement of engineering matters, with no implication of lack of truth, but because of slackness of expression which could not be overlooked when made by an engineer before an audience of engineers. An examination of the figures given shows the continuous duty of the station to be 18,000 kw. with good luck. He questioned the claims made for new and radical features. The record plant with which every engineer is familiar is at Dunstans, with the auxiliaries motor-driven throughout. The boilers of the Cleveland plant are rather less than half the size of those of the same type at Delray which have been in service five years and there is nothing radical in the increase of steam pressure from 225 to 275 lb. The balanced draft he remembered to have seen in use in torpedo boat practice when he was a "cub" on the Clyde.

Another inaccurary is in reference to the figures upon the kilowatt hours generated. A note should be inserted that something like 10 to 15 per cent of this power is used in the station itself.

Edward W. Bemis[1] in a written communication stated that he believed no candid student of the subject could doubt that Cleveland by its municipal control in various matters is securing better results than state regulation would secure. In the case of the Cleveland street railways certainly and until now, at least, in the case of the private electric light plant there, it has not deprived the private company of a fair return on its actual investment in the property, using investment to cover moneys furnished by the stock and bond holders in addition to good dividends from the start.

At the November Conference of Mayors in Philadelphia, Mayor Hocken of Toronto declared similar results were being secured by similar methods there. If these experiments continue to succeed, it is evident that state regulation will have to cease allowing companies returns on unearned increments, donation and surplus earnings invested in their properties, or existing laws in the various states will be changed where necessary to permit direct municipal competition under proper safeguards of publicity and uniform accounting, referendum on bond issues, etc.

It will be recalled that this method of potential municipal competition was endorsed by the National Civic Federation Commission on municipal versus private management, in 1907, as the most effective method of control.

When the efficiency of public operation approaches that of private operation, the handicaps upon the latter, through its demand for returns which public operation never makes, such as going value, and the increased cost of replacement as compared with actual cost, etc., to say nothing of differences in the demanded rate of return, will prove serious. Whether that time has yet arrived, and how far private companies will awake to the situation, as they have been doing in England, will vary with every community and with changing conditions.

R. P. Bolton, in a written discussion, said the first thing to be considered is the foundation upon which the economic features of the plant are based. He called attention to the author's statement that the South Brooklyn Station had "made the remarkable record of having acquired more than one-half of its total value in eight years from the earnings of the plant itself" and said that so far as the details

[1] 4500 Beacon St., Chicago, Ill

of these earnings are made available in the paper itself he felt that the diversion of such earnings was not warranted.

According to the figures of the author, the capital investment to the end of 1913 was $320,796 and the amount added from the earnings prior to providing for necessary fixed charges was $306,533, or a total of $627,329.

This account is credited with $109,147, which could or would have been paid to a local company for street lighting. This amount, however, almost exactly offsets a book charge for depreciation of $113,244 so that any money for the latter necessary purpose has been burnt up and the value exists only as a book debit. The character of part of the earnings may be seen by comparing the figures of operating income in Table 3 with the item for 1913 in Table 2. The net earnings for 1913 were $68,979; earnings put back in the plant, $66,622; which leaves only $2,357 to pay fixed charges of $19,079.

The income of the South Brooklyn plant had been secured in 1913 by an average sale price of 3.28 cents per kw-hr., while for the first eight months' operations of the old and new stations the rate had decreased to 2.44 cents per kw-hr.

The direct loss on the South Brooklyn system is therefore 84/100 of a cent, and allowing for the economy in production cost due to the new plant's operation, the net loss is............	$31,100

Turning to the figures of operation of the new plant, we find:

The earnings for August were, at the average rate of 2.07....................................	$19,405
Average of 8 months monthly operating cost.....	12,130
Leaving for administration and fixed charges....	7,275
The fixed charges are stated to be per month.....	22,500
Resulting in a deficiency, for the month, of......	15,225

It is upon this somewhat ricketty foundation that the basis for estimating results in the 53rd Street Station has been predicted.

The writer contends further that the successful financial operation of the plant is dubious, not only by reference to the data upon the operation of the Brooklyn station, but also in consideration of the character of the service to be rendered and the rates to be charged.

The service is to be for alternating current only, which for much of the business of Cleveland will be unattractive and much direct-current machinery will have to be altered or discarded for its adoption.

Details of the rates are not given in the paper, but from those which he has found in the records of the municipal council he believes they are such as to offer but little inducement to those customers whose usage is the most desirable in producing a high load factor. A diagram plotted by the writer indicates that the inducements of the rates are toward high connected capacity which is a source of production of high peak and low load factor.

He asked: Are there any data in the paper which justify the expectation that the small consumer can be served at the rate of 3 cents without loss, which must be borne by other consumers or by a deficit in operation? The total costs of the 936,000 kw-hr. sold in August were, without administration, $34,630, or, per kw-hr. 3 7/10 cents. The figures made public by the Detroit Edison Co. show their cost of service connection, upkeep, meter installation, lamps, accounting and bill to be per customer $8.41 per annum. This is over and above the cost of producing and delivering the energy used.

The Author said that he had been told so often that they were radicals up at Cleveland that he was glad to learn that Mr. Dow did not consider anything in this station to be at all radical and that they had built a plant so nearly like the Delray station. There was no reason why the latter should not sell their current at the same price as the Cleveland station and he hoped to see them do it.

With regard to the capacity of the station, there is some degree of uncertainty in the method of rating power station machinery and power stations. He understood that stations at the present time are generally rated upon their maximum continuous capacity. Tests showed that these turbines are capable of 7500 kw. continuous capacity; three of them would give 22,500 kw. and the auxiliary machine would add 1500, making 24,000 kw. maximum continuous capacity. That was the basis on which he had made all his statements in regard to capacity.

In Mr. Cravath's discussion, the figure of $365 is the cost per kw. of the entire Brooklyn plant, including the distributing system. As shown by the appraisal, he thought the value of the distribution system was about $200 per kw. and of the station itself from $160 to $175.

As to whether it will be possible to get a 40 per cent load factor, the system is now running with between 60 per cent and 80 per cent load factor and while he realized that as the load was built up they would secure a much poorer load factor, he believed it would not go below 40.

The question has been raised in regard to cost per kilowatt-hour. It is true that this differs greatly for different classes of customers and the Cleveland plant is radical in that respect in that it is selling current to some customers at a loss.

The waterworks department at Cleveland is selling water at a uniform rate to everybody, the smallest household user as well as the factory. That is probably going to the other extreme, but they are subject to no competition. Of course, this cannot be done with electric current. Outside of the question of competition, if there were only one station and every customer had to take that current or none at all a single rate could not be maintained. Current could not be sold to the small residence customers at as low a rate as it would be necessary to sell to power customers and the business could not be obtained, on the other hand, if power customers were charged at a higher rate than residence customers.

Mr. Bolton raised a question as to the $66,000 reported turned back into the plant from earnings, whereas $49,000 is shown in the report as profit. This, however, is correct although it appears on the books in the way of depreciation. Many companies are mistaken at the present time in setting up 10 or 15 per cent for depreciation year after year. The point will soon be reached where the book value of the plant is very much less than the actual value. He instanced the case of a large company, the plants of which he had appraised, and found the value to be thousands of dollars more than their books showed, simply because they had been writing off too much depreciation. This method of setting up depreciation was followed with the Brooklyn plant and is where the difference comes in between the $49,000 and the $66,000.

FOREIGN REVIEW AND REVIEW OF PROCEEDINGS OF ENGINEERING SOCIETIES

ENGINEERING SURVEY

The war in Europe has materially affected the files of foreign periodicals. While most of the papers come in with fair regularity, both their size and intrinsic value of contents have suffered to a noticeable degree. The Belgian papers have been discontinued entirely, the French appear in a reduced size, while most of the German papers have adopted the system of publishing double numbers, sometimes with less reading matter than the former single number. When, however, one sees the long lists of the members of various engineering societies fallen on the fields of battle, one has no difficulty in understanding the decrease in the output of papers.

THIS MONTH'S ARTICLES

The investigation of a gas-driven compressor air plant at the Mine Consolidation is of interest because it is the first large air compressor plant so driven in Germany, and while there is nothing startling in the results obtained, the overall efficiency of the installation is fairly high.

Attention is called to the article on Pelton turbines, especially because it is believed to be the first authentic information on the Fully plant, using the highest head of water, in a single jet, in the world. In the same abstract, data are given on the Dufour water wheel governor.

In connection with an article on a 1000 h.p. Diesel engine is reported a method of governing the pressure of the fuel injection air, which will facilitate the use of Diesel engines on constantly varying loads, such as are met with in central stations supplying energy to tramway systems.

The article on elastic hysteresis does not present anything essentially new, but it is reported here because it refers to a matter to which hardly enough attention has been given in American engineering papers.

The section on steam engineering contains several interesting articles. Tests are reported on the use of eddy rings, a device somewhat similar in shape, though different in action from what is known in this country as retarders; data on accident in gas fired boilers are reported, and a new type of traveling grate is illustrated and described. Further, a new type of liquid fuel burner, of the adjustable kind, is described, it is also stated that this type of burner has been a success in the Austrian navy.

In the last section the Plumboxan process of producing oxygen and nitrogen is described.

In the section Engineering Societies, the following papers are reported or abstracted:

E. S. Christian, in a paper before the American Wood Preservers' Association, gives data on the preservation of a pier at Newport News, Va., against the action of marine borers by means of dead oil, the pier having withstood the attacks of the borers now for 32 years.

J. H. Waterman presents data on ties treated by various processes such as the Full Cell creosote, zinc chloride, Wellhouse and Card processes. Also a specification for a coal tar creosote solution is reported.

Milton L. Sims, in a paper before the Central Railway Club discusses the matter of painting of steel cars and locomotive equipment and many other things, giving schedules of time for various painting jobs.

In a paper before the Corps of Engineers of the United States Navy, Captain W. A. Mitchell presents important experimental data on the percolation and upward pressure of water necessary in order to design dams properly.

Tests on various reinforced concrete structures in England are reported in a paper by J. B. Hall before the Institution of Civil Engineers. Before the same body, S. H. Ellis presented a paper on the corrosion of steel wharfs at Hongkong, China, containing data which may be of interest to any engineer working in the tropics.

Particular attention is called to the paper by Thomas Bryson before the Institution of Mining Engineers, on the testing of fans with special reference to the measurement of pressure, and containing other things and valuable data on the efficiency of various forms of water gages.

Genjiro Hamabe, of the College of Engineering of the Kyoto Imperial University, discusses the disturbing actions of a shaft governor. While the paper is too mathematical to be fully abstracted in some of its parts, an attempt has been made to present the main line of reasoning of the author in a moderately readable form.

The two papers by Professor B. Hopkinson, on the charging of 2-cycle internal combustion engines and H. F. Fullagar on a new type of internal combustion engine before the Northeast Coast Institution of Engineers and Shipbuilders refer to tests on the same engine, but Professor Hopkinson's paper takes up the entire subject of charging, which he discusses in a novel and highly interesting manner.

The analysis of coal with phenol as a solvent by S. W. Parr and H. F. Hadley gives not only a method of coal analysis but presents data of material interest to all those who have to do with the utilization of coal in a boiler, furnace, coke oven or gas producing plant.

FOREIGN REVIEW

Air Machinery

Investigation of a Gas Driven Air Compressor Plant at the Mine Consolidation.

The article describes a gas engine driven air compressor installation at the Consolidation mine in Germany and gives data of tests of this installation.

While gas engines have been used widely to drive electric generators, their use for air compressor operation in Germany appears to have been very small and only in installations of an experimental nature. The present installation, therefore, represents a very bold advance involving a compressor handling per hour 15,000 cbm. (say 530,000 cu. ft.) from atmospheric pressure to a pressure of 6 atmospheres gage. The gas engine is a four stroke cycle twin tandem engine working on coke-oven gas with a heating value of from 4,000 to 4,500 WE, (448 to 504 B.t.u. per cu. ft.). The high pressure and low pressure cylinders of the air compressor are directly connected to each of the sides of the gas engine, each side of the engine being so designed that it can compress as a single stage compressor from 4800 to

7000 cbm. (169,500 to 247,200 cu. ft.) per hour to a pressure of 5 atmospheres, according to whether the high or low pressure cylinders are operated. The arrangement is such that even when the engine is being cleaned, or undergoing repairs, the compressor is still partly running.

When the engine is operated at its full capacity of 15,000 cbm. per hour it has a speed of 90 r.p.m. The compressor has Horbiger-Rögler plate valves conveniently located in

TABLE 1 TESTS OF A GAS ENGINE DRIVEN AIR COMPRESSOR EQUIPMENT

Duration of test, hr.	6
Barometer pressure, mm. water	753.75
Temperature of air sucked in, deg. cent./fahr	13.25/55.9
Temperature behind the low pressure cylinder, deg. cent./fahr	102.8/217.1
Temperature behind intermediate cooler, deg. cent./fahr	31.4/88.6
Temperature behind high pressure cylinder, deg. cent./fahr	112.8/235.1
Compressed air pressure, atmospheres gage	6.6
Volumetric efficiency of compressor, per cent	87.7
R.p.m	90.6
Air output of compressor, cbm/cu.ft.	15.277/539.493
Power consumption of compressor, i.h.p.	1479
Indicated output of gas engine	1774
Mechanical efficiency of the plant, per cent.	83.4
Low pressure side:	
R.p.m	73.5
Volumetric efficiency, per cent	49.9
Air output per hour, cbm/cu. ft.	7051.6/249,004
Compressed air pressure, atmospheres gage	5.1
Average temperature of compressed air, deg. cent./fahr	138/280
High pressure side:	
R.p.m	87.3
Volumetric efficiency, per cent	72.9
Air output per hour, cbm/cu.ft.	4767.2/168,345
Compressed air pressure, atmospheres gage	4.9
Average temperature of compressed air, deg. cent./fahr	138/280

a valve chamber in such a way that they can be easily exchanged. In order to attain as low an air temperature as possible and, further, in order to comply with the police requirement that the temperature in a single stage compressor should not exceed 140 deg. cent. (284 deg. fahr.), the walls of the compressor as well as the compressor piston are water-cooled. The intermediate cooler which permits the cooling down of the partly compressed air to the temperature of suction is placed in the floor in an accessible position. A tube filter of the Blass type is used for cleaning the air in suction.

The engine was subjected to an acceptance test in the period from September 29th to October 4th, 1914, and a further control test on October 13th. The work of the cylinders of the gas engine and compressor were determined by indicating the air pressure and temperature by properly calibrated manometers and thermometers, while the heat content of the gas was determined by analysis and by means of a Junker calorimeter.

In order to eliminate the influence of outside temperature and the action of sun rays on the gasometer, all the tests were carried out after the sun went down. Nevertheless it has been found in testing the air tightness of the gasometer that the pressure lever continued to sink after sundown and this led to the control test on October 13th. The data of the test are shown in Table 1. This test has shown that the plant as it stands did not satisfy entirely the very exacting requirements of the contract but that it was fairly efficient. During the entire test, the engine ran quietly without causing any trouble, and no disturbances of any kind in the operation of the plant were observed. (*Untersuchungen des Gas-Luftkompressors auf der Zeche Consolidation*, report of the Boiler Inspection Society of the Mining District of Dortmund at Essen, *Glückauf*, vol. 50, no. 51, p. 1717, December 19, 1914, 4 pp., 5 figs., *de*).

Hydraulics

Pelton Turbines and Their Governors.

The article (continuation of the one abstracted in *The Journal*, January 1915, p. 44) describes Pelton turbine installations in Saaheim, Norway and Fully, Switzerland.

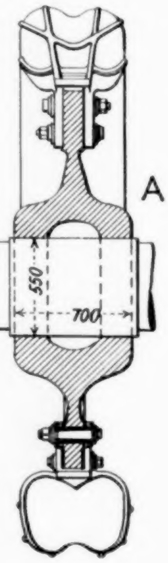
The installation in Norway was built for a fall of 253 m. (830 ft.) and an output of 16,400 h.p. at 250 r.p.m. It is a turbine with two wheels and two needle nozzles per wheel. The average diameter of the wheels is 2.4 m. (94.4 in.), the number of blades, 26, and the maximum diameter of the jet, 0.164 m. (6.4 in.). A figure shows the disposition of the nozzles, water admission to them and regulation and distribution of the blades in the wheel, the casings with the foundation frame and the arrangements for letting off water into the shaft. Fig. 1 A indicates the method of holding the blades.

The turbine is equipped with a combined needle displacement and jet deflection in accordance with the Leon Dufour patents. Fig. B, p. 45 indicates the method of operation of this system of control in a manner which permits its comparison with the method of control indicated in Fig. C, p. 45. *The Journal*, January 1915. The rocker *abc*, with the rigidly located center of rotation at *b*, is, at *a*, connected with the pistons of the servomotors. At *c* is suspended the first main element of mechanism, viz. a bar *cd*, bent in accordance with the predetermined curve, this bar being connected with the needle rod by means of the deflector *de*. The bar is further connected with the jet deflector by means of a rod *ik*. The servomotor consists of two parts, viz. of the main servomotor, equipped with a differential piston and a displaceable pressure servomotor located coaxially with the main. The casing of the latter is inserted into the smaller working space of the main servomotor so that an axial displacement of this casing is possible. The piston of the pressure servomotor is connected rigidly and invariably with the piston of the main servomotor, while this casing is connected by means of the guide *fg* with the jet deflector. With the rigid bearing of the rocker *abc* is connected a roller which limits the deflection of the bar to the right.

From the above description and Fig. B (which, however, represents the construction only diagrammatically), it is clear that as long as the permanent contact is maintained between the bar and the roller, each position of the piston, 0, 1, 2, 3, 4, of the main servomotor corresponds to a definite position indicated by similar numerals of the deflector edge σ.

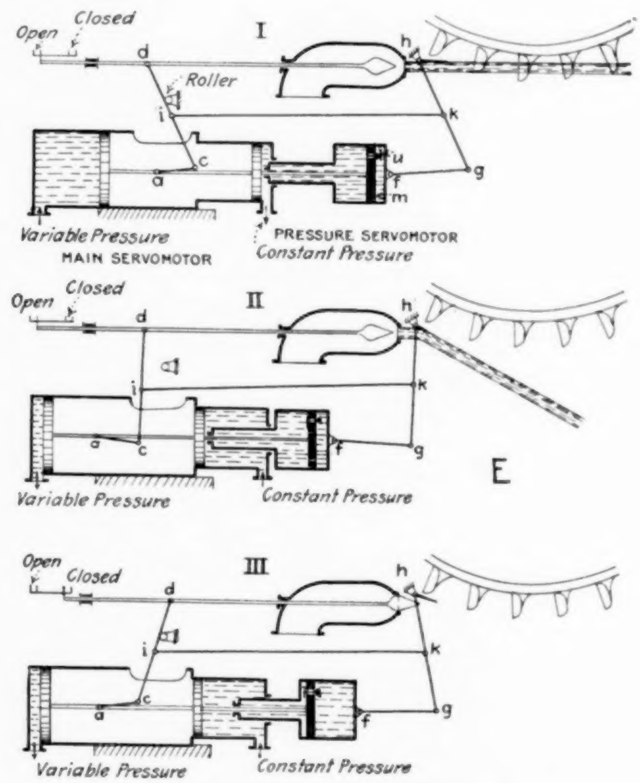
The Pelton turbine of the Fully plant is of the greatest interest because in the plant, a total flow of 1650 m. (5412 ft.) between the Lake Fully and the valley of the Rhone is utilized in one stage, which naturally leads to the necessity of solving some quite interesting problems in the selection of materials and design of piping for stresses produced by such a head. No complete data have been published as to the method of conveying the water and of the piping. The author is only enabled to state that the total piping is 4625 m. (15,172 ft.) long; that its upper part, 2300 m. (7545 ft.) long uses a diameter of 0.6 m. (23.6 in) while in the remaining lower part, the diameter is 1.5 m. (19.6 in.);

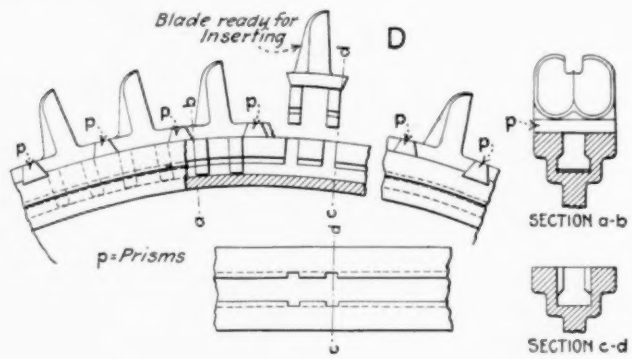
that the thickness of the walls of the pipe varies from 6 mm. (0.23 in.) to 43 mm. (1.69 in.). Up to a thickness of 34 mm. (1.33 in.), the steel piping has been produced with longitudinal and cross seams welded by a special process. The piping of a thickness of 34 to 43 mm. consists of pieces drawn from single block without longitudinal seams and combined into pipe sections by autogenous welding, the connection between such sections being made by welding on connections with loose flanges and rubber ring packing. The entire main piping is located underground and is covered with earth at least 1 m. deep.

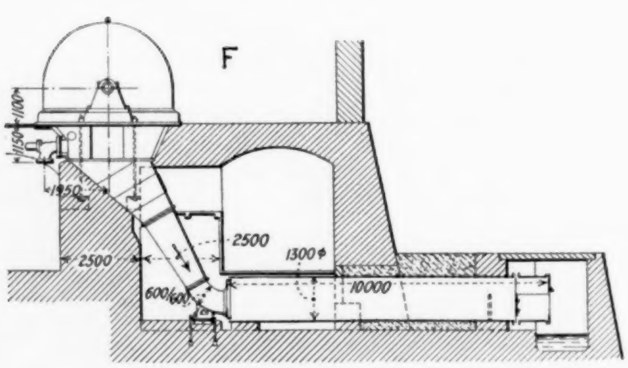


The prime movers consist of five units of 3000 h.p., each driving polyphase generators operating at 10,000 volts and 50 cycles. The turbine installation as shown in the original article has a runner of 3.55 m. (11.65 ft.) theoretical diameter with 54 pressed steel blades. The method of fixing and holding the blades is shown in the lower left hand section of Fig. D. The 54 blades are distributed into nine groups of six blades each, such groups being separated by trapezoidal prisms.

indicated by similar letters. Fig. E shows also the fundamental geometric conception of the device characterized by the parallelogram consisting on one hand of the rocker dc, between the servomotor and needle rod, and the rocker hg, parallel to dc when the nozzle is fully open and connecting the pressure servomotor and jet deflector; and on the other hand, first, by the parallel axes of the servomotor and, second, the needle. In other positions of the needle and deflector, the parallelogram becomes an irregular quadrangle in which the two sides formed by the axes of the servomotor and the needle remain parallel but are of different lengths, while the axes of the rocker depart from their parallel positions.







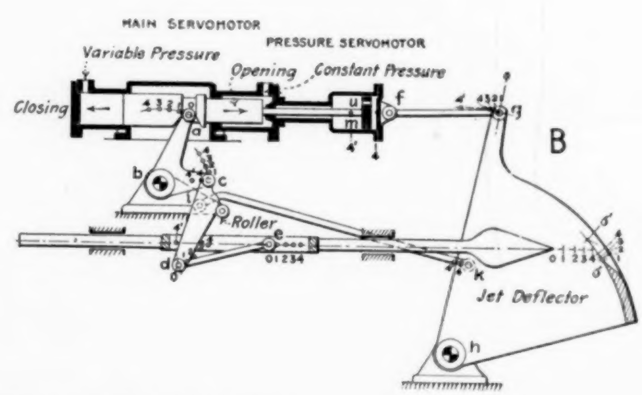


Fig. 1 Pelton Turbines, their Blades and Governors

This turbine is equipped with a combined Leon Dufour regulation similar to that described above but its actual construction, as indicated in Fig. E, is different from that used in the preceding case. In order to make the comparison between Fig. E and Fig. B easier, similar parts are

With the fall of 1650 m. available, the velocity with which the water leaves the nozzle is somewhere around 180 m. (590 ft.) per second and even after it leaves the wheel, it still has a velocity of from 35 to 40 m. (105 to 131 ft.) per second. It is of particular importance therefore that the

water should not strike the walls of the outflow shaft, and an arrangement resorted to is shown in Fig. F. It consists of a special cast iron shield on the upper end of the shaft and close to it, a sheet metal passage, located in an inclined position with a contraction toward the lower part, into which the various grids are built and which opens through a quarter bend into a horizontally located sheet metal cylinder 10 m. (32 ft.) long and 1.3 m. (51 in.) in diameter. (*Die Wasserturbinen und deren Regulatoren an der Schweiz. Landesausstellung Bern*, 1914, Professor Franz Prášil, *Schweizerische Bauzeitung*, vol. 64, no. 24, p. 257, December 12, 1914, serial article, not finished, *d*).

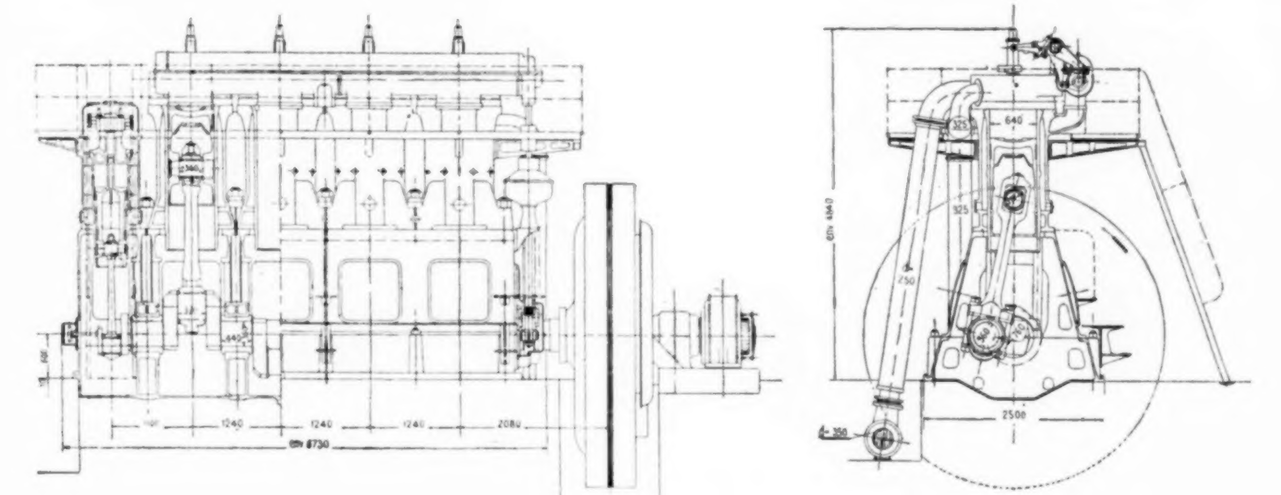
Internal-Combustion Engines

1000 H.P. Diesel Engine

The article describes in addition to heat and refrigeration engines at the National Swiss Exhibition of 1914 at Berne, a 1000 h.p. Diesel engine of a rather interesting type. (Fig. 2)

The engine is of the four-stroke cycle type with four fixed cylinders. In addition to a judicious disposition of the cylinders held by vertical steel tie-rods, the engine has also an automatic regulation of the pressure of the fuel injection air. To make the combustion more perfect, this pressure has to be regulated in accordance with the charge. In this case, the speed governor of the engine provides for this kind of regulation. To each load there corresponds a certain predetermined position of the governor sleeve and this, by means of a cylindrical valve, permits the throttling, more or less, of the admission of air into the first stage of the fuel injection compressor. The variable initial pressure causes a fluctuation of the final pressure which later attains a maximum for large charges and is reduced by about one-third for small charges. Further, by means of a servomotor and through a variable pressure at one of the stages of the compressor which delivers the air of injection, it is quite possible to regulate the motion and the time of opening of each fuel valve. As a result, the air of fuel injection can penetrate into the working cylinder only in quantities fully subject to regulation, so as not to be in the way of the propagation of the flame at the instant of the combustion of the injected fuel.

The air of injection should always have a pressure several atmospheres above that which exists in the cylinder at the end of compression. If this air has been sufficiently cooled after each compression, it will have essentially the temperature of the surrounding medium, and the latter will, to a sufficient extent, go down during the expansion, to cause a considerable cooling and to provoke not only a defective combustion, but if the air of injection enters in too large quantities, a failure of ignition, which in its turn can cause grave disturbances in the regulation and make working in parallel impossible. The Sulzer regulation entirely eliminates this cause of trouble and permits the building of motors for constantly varying loads, such, for example, as in central stations supplying energy to tramway systems, etc. *Les machines thermiques et frigorifiques à l'Exposition nationale suisse de 1914, à Berne*, Professor J. Cochand, *Bulletin technique de la Suisse Romande*, vol. 40, no. 23, p. 261, December 10, 1914, serial article, not finished, *d*).



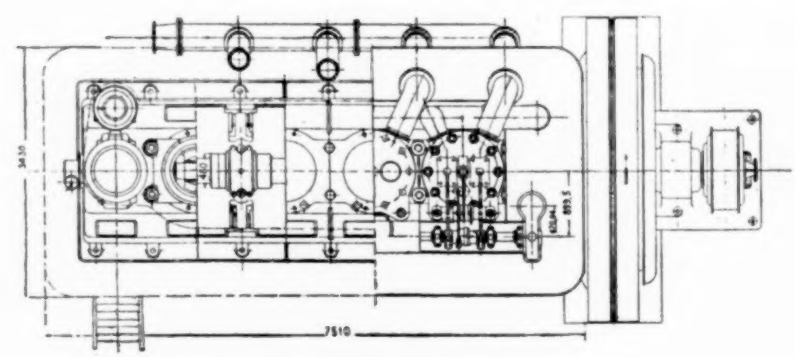


Fig. 2 A 1000 H.P. Diesel Engine

Mechanics

Recent Experiments on Elastic Hysteresis.

Discussion of phenomena of elastic hysteresis in solid bodies.

When a solid body is subjected to an elastic deformation within certain limits, the deformation is exactly proportional

to the force applied. This region of deformation is known by the name of Hooke's, and its limit is called the limit of elasticity. It has hitherto been accepted in the theory of strength of materials that an elastic deformation within the Hooke region is reversible, even though there are certain phenomena which contradict this view, such for example, as the fatigue of materials. Lately, however, by the application of especially delicate methods of observation, the processes occurring in elastic deformation within the limits of elasticity have been better investigated experimentally, and it has been found that the proportionality between deformation and force applied, as expressed by the Hooke law, does

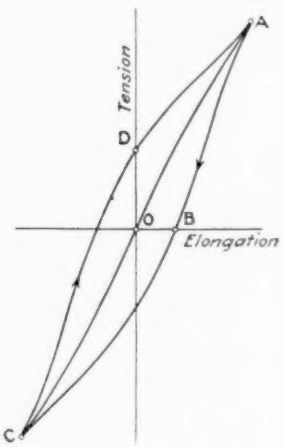


FIG. 3 HYSTERESIS LOOP OF ELASTIC DEFORMATION

not hold good exactly, and one cannot strictly speak of the reversibility of this process. On account of the similarity of the processes (see the tension-elongation diagram in Fig. 3) with magnetic hysteresis, this phenomenon was called elastic hysteresis. It may be explained by the assumption that the deformation lags behind the force so that if the point of reversal be suitably selected, a closed curve process can be produced.

In the above diagram OA is the virgin line of the material newly stressed in tension. ABC shows its contraction down to the state C and CDA the more recent expansion into the state A. The curve becomes a closed one when A and C are symmetrically located with respect to the zero point and in further cycles of the process practically the same path is repeated over and over again in the direction of the arrow. Further, since the energy of a unit of volume of a body elastically deformed is given by the expression $\int \sigma d\varepsilon$ where σ is the stress, and ε the deformation, the area of the hysteresis loop in a circular process is numerically equal to the work lost per unit of volume, such work having been partly transformed into heat and partly used up on the displacement of the molecules, and has thus possibly led to the rise of fatigue in the material.

It may be added that this phenomenon occurs in as pure a manner as here indicated only when the stresses remain within the Hooke region and when so large a number of these cyclic processes have been gone through that the material has sufficiently adapted itself to the process. In addition to that, the hysteresis phenomena are always superimposed by the so-called elastic reaction which after each application of strain permits the molecules to assume their initial position of rest only after the lapse of hours and sometimes days.

The author proceeds to the presentation of data on elastic hysteresis obtained by Professors Hopkinson, Trevor-Williams and F. E. Rowett in their tests in the Engineering Laboratory in Cambridge which were published in the Proceedings of the Royal Society of London, Ser. A, vol. 87, p. 502, and vol. 89, p. 528. (*Neuere Versuche über elastische Hysterese*, Dr. R. Grammel. *Zeits. des Vereines deutscher Ingenieure*, vol. 58, no. 48, p. 1600, November 28, 1914. 3 pp., 3 figs. *te*).

Steam Engineering

BOILER ACCIDENT

The article describes an accident to a boiler fired with producer gas.

It is taken from a report of the Mountain Boiler Inspection Association of Barmen, Germany. The boiler was of the double flue type, fired with producer gas, with the steam collector in the upper flue, 100 sq. m. (1076 sq. ft.) of water heating surface and 6 atmospheres licensed pressure. Up to the time of the accident, the boiler had been in operation for nearly 7 years. The gas was developed in a coal gas producer located in the boiler house, while the combustion chamber was directly in front of the boiler. The first rings of both flues were covered with fire clay lining with an inner diameter of 580 m. (22.8 in.). According to the general regulations for licensing gas fired boilers, the ratio of grate area to water heating surface (such "water heated surface" being that which the heating gases play on, before they reach the heating surface in contact with the steam) was determined on the basis of an ideal grate area of 2.1 sq. m. and a ratio of grate area to heating surface as 1:47.5. The air was forced into the combustion chamber by a fan. When the plant was licensed in 1905, the minimum cross section of draft was used for the determination of the ideal grate area, as in the inspection regulations at that time, there was no precise indications as to the methods of calculating the grates.

In June 1913, the boiler was cleaned, but this cleaning had to be done with great speed as another boiler which was also fired by producer gas met with an accident in the meanwhile. After the boiler had been started again, it was fired at a high rate for 24 hours, but it was found impossible to obtain any noticeable pressure. At the same time, the evaporation appeared to have been quite strong as it was necessary to supply feed water all the time. When the fire was allowed to go out, it was found that the parts of the boiler shell and the steam collector shell in contact with steam must have been red hot. The shell girth seams had been drawn apart, so much that one could see through them into the inside of the boiler. The steam collector shell indicated strong outward bulging, while the front sheet of the collector was blown out into a hemisphere. The steam which was produced during the heating evidently escaped through the openings in the seams at a very low pressure into the upper flue and thence into the smoke stack.

Investigation has shown that the accident was due to the after-burning of gases in the upper flue which had not been burned entirely in the combustion chamber on account of lack of air. It is quite impossible that the temperature

of the hot gases, after complete combustion in the combustion chamber, should have been so great when coming in contact with the steam heating surface that it could have produced such effects as were found in the boiler. It is quite possible, however, that the after-burning was helped also by the air coming directly into the upper flue. This accident indicates that in boilers precautions should be taken to prevent the steam heating surfaces from being acted upon by the hot gases, as incomplete combustion of the gases in the combustion chamber is always possible. *Aus der Überwachungspraxis, Zeits. für Dampfkessel und Maschinenbetrieb, vol.* 37, no. 51, p. 544, December 18, 1914, 1 p., *dp*).

Eddy Rings in Firetube Boilers.

The article reports tests with eddy rings, a special device for increasing the efficiency of boiler fire tubes.

The action of eddy rings provides for deflecting that part of the gas stream flowing through the fire tubes of a boiler which is nearest to the walls of the tube and therefore coldest and in this way mixing it with the hotter part of the gas stream, thus securing a fuller exchange of heat between water and gas. The construction of the eddy rings is shown in Fig. 4A. From it, it is seen that the action of the eddy rings

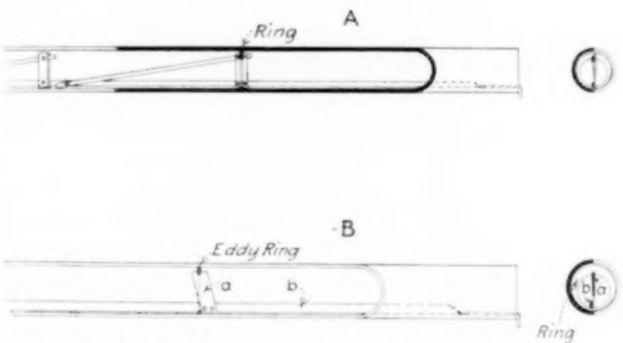


FIG. 4 EDDY RINGS FOR MARINE BOILER TUBES

is essentially different from that of retarders, in which the gas stream is divided into two parts and is given a helical forward motion, without, however, enabling the inner hot gases to reach the walls of the tube.

The first tests with eddy rings of the Pielock system were made in 1910 and on the whole, have been successful. It is now stated that 50 ships have been equipped with the Pielock rings. The article gives detailed data of tests made with and without Pielock rings on various steamers, mainly barges and tugs. It may be of interest to state here that the first Pielock rings were installed on the condition that the coal saving should be guaranteed at not less than 10 per cent; that a fine of $50 be paid by the company installing the rings for each 1 per cent of saving of coal less than 10 per cent and that should the saving in coal not reach 5 per cent, the company would take out the rings free of charge and defray the entire cost of the test. Under these rather severe conditions of contract, a saving of 15 per cent was effected.

As an example of the various tests reported in the article, we may select those made with three tug steamers, Moritz, Otto and Ernst (Table No. 2). The trips were all made against the tide, drawing one barge of approximately equal load in each case and using the same kind of coal in the boilers.

The author states that eddy rings can be used also in superheaters, a part of the tube cross-section being occupied by the superheater coils. It is necessary, however, in such a case that the free section of the tube be large enough to provide for an unobstructed passage of the gases. It does not appear that these rings affect the draft in the smoke stack, but it is quite possible that after the installation of the superheater the draft in the smoke stack may be reduced to such an extent as to weaken materially the action of the eddy rings.

Practice has shown that the installation of the rings involves certain difficulties. In the first place, the diameter of the tubes is not the same throughout and even in the same tube small differences are noticed in the free cross-section. Further, the data as to the internal diameter of the tubes

TABLE 2 TESTS OF EDDY RINGS ON TUG BOAT BOILERS

	Tug Moritz		Tug Otto		Tug Ernst	
	No rings	Eddy rings	No rings	Eddy rings	No rings	Eddy rings
Duration of test, min.	108	124	109	140	108	135
Boiler pressure, atm.	10	10	10	10	12	12
Cut-off, per cent.	55	55	65	65	65	65
Speed of engine, r.p.m.	162	162	156	156	164	164
Coal Consumption, total.....kg.	500	500	500	500	500	500
lb.	1102	1102	1102	1102	1102	1102
Coal consumption per hour.....kg.	277	241	275	214	277	222
lb.	609	530	605	470	609	488
Temperature of flue gases, deg. cent.	312	260	320	255	350	275
fahr.	593.6	500	608	491	662	527
Trailer, stn.	10000	10000	9500	11000	12800	13000
SAVING IN COAL, %%	..	12.9	..	22.14	..	20

are not always reliable and it has happened more than once that rings turned exactly to a supposed diameter of the tube, either did not go in at all or were so loose that they dropped into the firebox during the trip. This led to rejecting the direct insertion of the rings and adopting a different method. The rings are now turned somewhat smaller than the diameter of the tube, but each ring is held (Fig. A and B) by means of two flat iron bars, located along the axis of the tube in such a manner that the rings cannot then drop out. A series of rings therefore is put into each tube as a unit and can be quite easily withdrawn, for example if any repairs on the tubes have to be carried out.

This method of using withdrawable fire rings has proved to be very desirable in view of the ease of installation and for this very reason, such rings have a material advantage over the so-called retarders. Tests with these withdrawable rings have shown results practically similar to those with specially installed rigid rings. The author claims that eddy rings can be used to advantage also in feed water preheaters and air heaters of the Howden boiler installation. A figure in the text shows an air preheater for a modern boiler plant. In condensers, the rings can be applied only when the cooling water is pure, because otherwise, the deposits would rapidly reduce the free cross-section of the tube, but if the dimensions and arrangements of the rings have been properly selected, it is claimed that beneficial results can be obtained thereby. (*Betriebsergebnisse mit Wirbelringen in Feuerrohrschiffkesseln*, Forst, *Schiffbau*, vol. 16, no. 4, p. 72, November 25, 1914. 6 pp., 6 figs. *de*).

Placzek Traveling Grate.

Description of a traveling grate essentially consisting of chain elements and intervening grate bars.

The main purpose of the new construction was to avoid as far as possible the rapid wear of the grate elements and to provide for an easy exchangeability of parts. Two guiding chains provide supports for the grate bars while the links of the chain carry the grate bar supports on which lie the grate bars themselves either longitudinally to or across the motion of the grate in such a manner that they may be easily removed when desired. In this way, the chain itself lying outside of the path of the grate proper is not affected directly by the heat of the furnace and is rather subject to a cooling by the air of combustion, which results in its wear being considerably longer. Further the grate bar elements can be shaped in any desired way and a grate surface can be obtained so as not to be fully continuous. As a result of that, it is more uniformly and efficiently cooled by the air of combustion. In changing to a different kind of fuel, the economic combustion of which requires a different type of profile of the grate bars it is not necessary to replace the entire grate. All that has to be done is to put in a set of new bars of the desired profile, as the old and used up bars are being taken out.

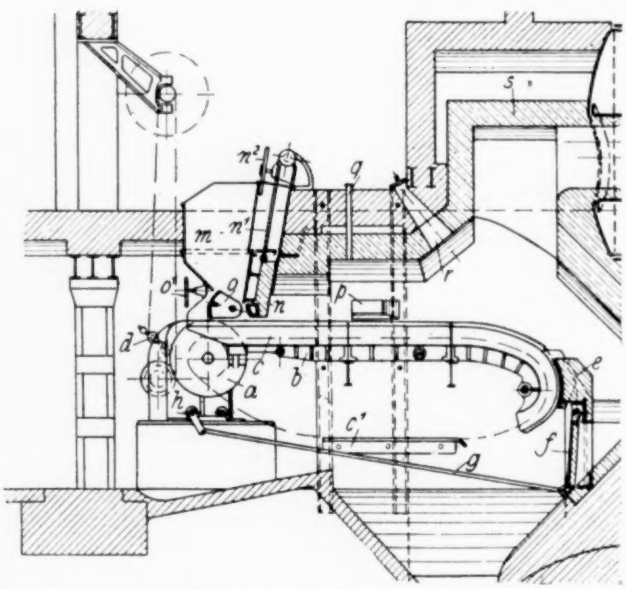


Fig. 5 Placzek Traveling Grate

The traveling grate of this new construction in which the separate grate bars, together with their bearers, can be so easily exchangeable that it is not necessary to have the entire grate removed, has been patented in Germany by Placzek. It is shown in Fig. 5. The grate as shown is 2650 mm. (104 in.) long and 1700 mm. (66.9 in.) wide. Essentially it consists of the two chains running right and left on rollers at c c^1 which carry the grate bar bearers and through them the grate bars themselves. The guides c are located in passages b in the brick wall, while the chain itself, and by it the entire grate, is carried forward over the driving drum a. The rear guide is limited to the terminal section of the grate which is provided with a suitable curve. The drive of the grate by means of the driving drum is continuous and is effected by a worm gear drive running in an oil filled gear case on ball bearings with staged discs and belt tighteners d in such a manner that the movement of the grate can be easily and quickly adjusted to three or more different speeds. The grate bar bearers located cross-wise are placed in the elements of the chain in such a manner that they can be easily withdrawn. The grate bars, selected so as to have the full path adapted to the kind of fuel used, have an essentially triangular cross section and should be placed on the bearers by one of the corners. In the upper part of the path of the grate they are, on account of their system of guiding, in such a position that they overlap one another and a practically closed surface is presented to the fuel. The part of the bar lying in front of the coal hopper end is just in this position, but when the rows of the grate bars are carried over the rear curved guide, the guides tilt around the bearers and then in the lower grate they hang downwards practically free so that they can be easily pulled out. (*Der Wanderrost System Placzek*, Pradel. *Zeits. für Dampfkessel und Maschinenbetrieb*, vol. 37, no. 49, p. 523, December 4, 1914. 3 pp., 3 figs. *d*).

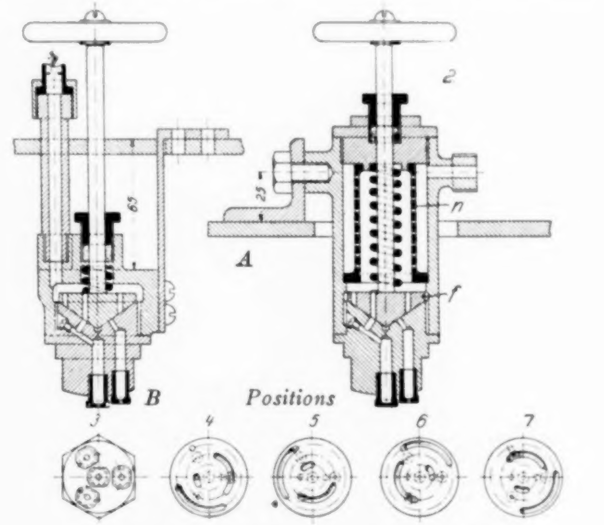


Fig. 6 Adjustable Burner for Liquid Fuel

Adjustable Burner for Liquid Fuel.

Description of an adjustable burner for liquid fuel, especially naphtha, of late widely used on Austrian ships.

The burner, as shown in figure A, permits very good regulation of fuel admission simultaneously with perfect atomization of the fuel which is made possible through the fact that the atomizing tip of the burner, provided with several nozzles, is equipped with a regulating device made in the shape of a rotary valve. According to the position given to it, this device either closes all the nozzles or permits the connection of a desired number of such nozzles with the fuel admission pipe.

The atomizing tip of the burner equipped with four atomizing nozzles is screwed into a casing of the burner. One of these nozzles is located in the center of the atomizing tip, while the others are disposed around it in a circle. The fuel passages leading to them open into a conical hollow opening in the atomizing tip in such a way that two of the fuel passage openings are located opposite one another at equal distance from the center of the working surface of that

hollow opening, while openings of the two other passages are disposed along circles of equal diameter and at distances of about 120 deg. from each other. (Compare Figure 6 A.)

On the atomizing tip is located a rotary valve which can be rotated by means of a spindle and hand-wheel and is pressed against the atomizing tip by a spring. In this rotary valve, there are three circular slots, two long ones extending over an angle of somewhat more than 90 deg., and a third slot, somewhat shorter. The radii of curvature of these slots correspond to the radii of the circles over which are located the openings of the fuel passages, so that in a proper position of the rotary valve, the shorter slot is located opposite the two inner passages, while the longer slots are opposite the outermost passage, the middle slot being placed over the middle position. In this case, the crude oil fuel passes through the admission pipe to the slot in the fuel passage of the automizing tip standing in connection with the proper slots. As shown in Fig. B (4), the smallest slot of the tip is opposite the passage leading to the middle nozzle, while the other slots are still about 90 deg. away from the proper openings of the passage so that fuel is led in (5) only through the outer and middle nozzle which heat the upper part of the fire tubes particularly. With the further rotation through 90 deg. (6) the smallest slot covers the inner passage, while the rear end of the two upper slots are right opposite the corresponding passage openings, so that all the nozzles, with the exception of the central one, are in operation. Should the valve be turned through 90 deg. more (7) then all the slots come out of correspondence with the fuel passage openings and the fire in all the nozzles is put out. It is claimed that this type of burner in the Austrian marine has proved to be efficient. (*Einstellbarer Brenner für flüssige Brennstoffe, insbes. für Naphta, Der praktische Maschinen-Konstrukteur*, vol. 47, no. 51, p. 332, December 24, 1914, 2 pp., 2 figs., *d*.)

Miscellanea

THE PLUMBOXAN PROCESS FOR PRODUCING OXYGEN AND NITROGEN FROM ATMOSPHERIC AIR

The article describes the so-called Plumboxan process for the recovery of oxygen and nitrogen out of atmospheric air and the apparatus used for this purpose.

Plumboxan is a chemical compound representing the combination of a metallic plumbate salts of an alkali with a manganate, oxide of an alkali. For example, salts of a sodium basis and the following composition:

$$Na_2PbO_3 \quad Na_2MnO_4.$$

The idea of using a similar mixture is not entirely new and numerous tests in this direction have been made before, but when simple manganates are used they become soft during the period of evolution of oxygen, under the influence of high temperature and steam, and therefore lose more or less the porous state so essential for the evolution of a gas process; and as a result of that, the amount of gas given off gradually diminishes. As the author has found from his own experiments, this objectionable phenomenon is due to the formation or disassociation of hydrates of alkali which are evaporated through the action of the superheated steam. This secondary reaction destroys more and more the porous state of the material and the permanency of its chemical nature so that after a comparatively short time, it becomes necessary to introduce new material.

On the other hand, the manganates, on account of their rapid and easy formation, when a mixture of their components is heated in the air, are extremely convenient for use as extractors of oxygen from the air. All that was necessary, was to obviate the above described objectionable feature by proper means, and the author found that he could attain that by an addition of a plumbate salt. At the same time, he had previously been able to establish that in the presence of basic materials and a high temperature, it takes up oxygen from the basic oxygen and passes into orthoplumbate salts, which in their turn, under the influence of such hydratizing materials as steam, are converted into metaplumbates. Further, it is known that one of the general characteristics of plumbates is their ability to take up and give off basic oxides, and the author found that such would be just the right thing to take up the alkaloids from the manganates disassociated by water vapor and to reproduce them later on in a regenerating process. He actually found, on experimenting, that an addition of a metaplumbate and an alkali metal eliminated the vaporization of the alkali hydrate from the manganate and permitted the maintaining of the reaction material in a permanent working state.

The author describes in detail the respective chemical reactions and the construction of his apparatus. The Plumboxan process appears, from the description, to be quite simple. The air, after passing through cleaning chambers where it is freed from carbon dioxide, is driven by a blower, through a recuperator, into the main apparatus. After several minutes of regenerative action, the air current is shut off and practically simultaneously, the steam from a special boiler is admitted into the main apparatus where evolution of oxygen at once takes place. This oxygen is carried through the usual water seal system into a special gasometer.

As to the output obtained with this process, the data secured are only general. At 400 deg. cent. (752 deg. fahr.), in 5 minutes approximately 1000 ccm. of oxygen are obtained from 1 kg. of Plumboxan provided the material is in a good porous state. At 450 deg. cent. (842 deg. fahr.) 2000 ccm.; and at 500 deg. (932 deg. fahr.) 3000 ccm. and more are obtained. It is of interest also to notice that as the temperature rises, the oxygen becomes purer. Since the oxygen during the regenerative process is taken up from the air by the salt combination, nearly pure nitrogen is obtained as a by-product of the process. Further, the regeneration of Plumboxan by the air can be carried on at the same temperature as that of the evolution of oxygen.

The author discusses in considerable detail, the chemical part of the process and comes to the conclusion that catalysis plays an important part in this reaction. (*Das Plumboxan-Verfahren zur Gewinnung von Sauerstoff und Stickstoff aus der atmosphärischen Luft und die in der Versuchsanlage zuerst benützte Apparatur*, Professor Georg Kassner, *Zeits. für komprimierte und flüssige Gase*, vol. 16, nos. 8/9, p. 155, August-September 1914, 6 pp., 3 figs. *d*).

ENGINEERING SOCIETIES

AMERICAN WOOD PRESERVERS' ASSOCIATION

Advance papers, Chicago meeting, January 1915

The Bleeding and Swelling of Paving Blocks, Clyde H Teesdale

Sill Ties, F. J. Angier

Economical Use of Steam in Connection with Wood Preserving Plants, A. M. Lockett

Destruction of Timber by Marine Borers, E. S. Christian.

Since marine borers do not thrive in foul water and prefer the uncontaminated water of the ocean, Hampton Roads offers an ideal environment for the growth of teredo and its kindred borers. In this connection, the author presents some data on the history of the Chesapeake and Ohio Pier No. 6, at Newport News, Va., on Hampton Roads, just below the mouth of the James River. It is interesting because in this case, timber treated with 12 lb. of Dead Oil per cubic foot has withstood the attacks of marine borers for 32 years, while timber not so treated lasts not more than two years and is sometimes destroyed after one summer season. Piles were treated and used in rebuilding that pier in 1883, the amount of the treatment required being that each of the piles absorbed 12 lb. of Dead Oil per cubic foot. One of the tests made to determine this was to bore each pile in six places and if any boring showed a penetration of less than $1\frac{1}{2}$ in., the pile was rejected and treated again. The specifications under which the oil was bought called for not less than 60 per cent of naphthaline. The author believes, however, that in the treatment of cross ties and bridge timbers, the naphthaline fraction may be lower, provided that the percentage of pitch is increased; in view of the difficulty of obtaining oil with more than 35 per cent of naphthaline, he has lately recommended 16 lb. of oil per cubic foot for marine work in Hampton Roads. (9 pp., 8 figs. *dh.*)

Additional Facts on Treated Ties, J. H. Waterman.

The author presents data on ties treated by various processes.

In inspecting ties treated by Full Cell creosote process in experimental tracks on the Burlington Railroad, he found that a number of cotton-wood ties treated by this process, although softwood, are giving most excellent service and are in as good condition as any other ties treated by this process on the experimental truck. Further, ties so treated do not rail-cut as badly as ties treated with zinc chloride.

As to ties treated with zinc chloride (the Burnettizing process), the author found in going over a number of the Santa Fe lines and lines in Western Kansas that ties treated with this process have given very good results and that practically all of them gave nine years' life before they were removed. On the Illinois Central Railroad, the author found that ties treated with zinc chloride in 1904 were giving much better service than ties treated in 1907, but does not explain why.

On the Chicago and Eastern Illinois Railroad, the author saw ties treated by the Wellhouse process (zinc, glue and tannin). On that line, red oak ties so treated were placed in track in 1900 and special dating nails were placed in each tie. By actual count, in June 1914, there were still remaining in the track about 75 per cent of the ties originally placed, thus giving them a 14 years' life; the author has even seen a number of red oak ties treated with the same process bearing dating nails of 1899—most of these ties being in a very good state of preservation.

Until the price of creosote was advanced, the Burlington Railroad treated their ties with the process known as the Card process (an emulsion of creosote and zinc). While a large number of ties so treated are laid in the experimental tracks of the Burlington Railroad, it is too early to draw any positive conclusions and one can only say that the ties treated with the creosote and zinc show less mechanical wear under the rails than those treated with straight zinc. It appears that the oil in the ties treated with the creosote and zinc is drawn to the surface and lubricates the tie under the rail which causes less rail cut and surface wear and prevents the tie from checking. (7 pp., *ed.*)

A Specification for a Coal Tar Creosote Solution, Herman von Schrenck and Alfred L. Kammerer.

The authors give a specification for a coal tar creosote solution, the necessity for which arose from the fact that during the past year it has become somewhat difficult to obtain the usual supply of high grade foreign creosote, and there have been increasing inquiries for the mixture of coal tar and creosote. The writers, therefore, in coöperation with the Barrett Manufacturing Company, made a number of tests to determine the distilling points, specific gravity and viscosity of the various mixtures, by which they obtained the data given in a table in the paper. Based on this and similar determinations, they gave the following specification which is not regarded as final but only as an attempt to describe as briefly as possible an oil made up of coal tar and creosote with a certain percentage of coal tar:

The oil shall be a pure coal-tar product, consisting only of coal-tar distillates and oils obtained by the filtration of coal tar. It shall contain no admixture of crude tar. Water shall not exceed 2 per cent. Specific gravity at 38 deg. cent. shall not be less than 1.06 or more than 1.10. Matter insoluble on hot extraction with benzole shall not exceed 2 per cent. Viscosity (Engler) at 82.3 deg. cent. (180 deg. fahr.) shall not be more than 59 for 200 c.c. No variation above 59 seconds shall be allowed. On distillation by the standard method of the A.R.E.A., it shall yield the following fractions, based on dry oil: Not more than 1 per cent at 170 deg. cent.; not more than 5 per cent at 210 deg. cent.; not more than 30 per cent at 235 deg. cent. The residue at 355 deg. cent. shall not exceed 26 per cent. (4 pp., *p.*)

CENTRAL RAILWAY CLUB

Official Proceedings, vol. 22, no. 5, November 1914, New York City

Painting of Steel Cars and Locomotive Equipment, Milton L. Sims.

The methods of painting equipment of wooden construction would not be suitable for steel and the introduction of all steel equipment required the development of new methods based on an intimate acquaintance with paint pigments and vehicles.

The preparation of a steel coach for painting is of vital importance and demands close attention. It should never be left to inexperienced help and must be done thoroughly,

as the absolute removal of all scale, grease and corrosion is necessary before any protective coatings should be applied. Properly selected paint pigments combined with the proper vehicles will prevent the starting of corrosion, but the idea that paint coatings will stop corrosion when it has once started, is not correct. There are several methods for removing rust from steel, but the safest and most economical is sand blast for the outside of cars, while for the interior of a steel car, the speaker recommended the use of raw linseed oil and benzine or gasoline, in the proportion of one part of oil to two parts of benzine, applied with a brush and rubbed down with emery cloth or paper. The sheet steel used on the interior of cars is much lighter in weight and finer in texture and does not need sand blasting to obtain excellent results. After the rubbing down is completed, the surface should be washed with gasoline and wiped dry with rags or waste. It is then ready for the priming coat, which, in all cases, should be applied as soon as possible after the surface has been cleaned, especially in regard to the outside surfaces where the sand blasting process has been used, because when the atmosphere is damp or the humidity is heavy, corrosion will start up again in a few hours. Great care should be taken also to prevent the handling of the surface with naked hands.

The priming coat is very important and too much care cannot be exercised to see that it is done thoroughly, brushed out evenly and every bolt-head and joint coated perfectly, using suitable brushes for the purpose. The solid through trains, running from the ice and snow of the North to the tropical climate of the South, are especially liable to influences producing cracking and disintegration of paint and varnish films, on steel cars, much more than wooden ones. When the priming coat has dried sufficiently, the next step is to harden putty and to glaze coat over all the rough places, in which case the second coat or brush surfacer is used, which is designed to fit with the priming coat. This material must always be finely ground, and work and spread easily over the large surfaces. It must dry hard but elastic.

The next step is to apply a much heavier bodied surfacing material, which is then knifed off, leaving a very smooth surface, which requires much less rubbing to make it ready for the color coats. The old method of using block pumice stone and water is dispensed with and a more modern and safer method of rubbing the surfaces down smooth by using raw linseed oil and benzine in equal parts on emery cloth and then washing or wiping the surfaces off with clear benzine or gasoline on rags or waste. This method of surfacing does away with all danger from moisture and prevents the starting up of corrosion where sharp edges or bolt heads may be cut through the metal.

The paper describes further the application of body color, interior finish, the painting of floors, roofs, trucks and platforms and gives also the following schedules for painting the exterior of steel passenger coaches and locomotives:

SCHEDULE FOR PAINTING EXTERIOR OF PASSENGER COACHES

1st	Day	Apply priming coat.
2nd	"	Harden putty and glaze all rough and uneven parts of surface.
3rd	"	Apply coat of brushing surfacer.
4th	"	Apply coat of knifing surfacer.
5th	"	Rub out with emery cloth, using half and half raw linseed oil and benzine, instead of block pumice stone and water.
6th	"	Apply first coat of car body color enamel.
7th	"	(If Sunday) drying.
8th	"	Apply second coat of car body color.
9th	"	Stripe and letter.
10th	"	Apply first coat durable outside finishing varnish.
11th	"	Drying.
12th	"	Apply second coat of durable outside finishing varnish.
13th	"	Car is completed.

SCHEDULE FOR PAINTING A LOCOMOTIVE

1st	Day	Apply priming coat of special locomotive primer.
2nd	"	Harden putty and glaze coat all rough and uneven surfaces. (This does not apply to trucks, frame work, etc.)
3rd	"	Apply brushing and knifing surfacer to water tank or tender, cab, steam dome, sand box, etc.
4th	"	Rub out surface with emery cloth, using half and half raw linseed oil and benzine. Wipe off dry with rags or waste and clear benzine, being careful not to use too much benzine. Follow up with coat of black enamel. On best work, a coat of flat black is applied over all surfaces, except trucks, frames, etc., before the black enamel coat is applied.
5th	"	Letter and finish with a coat of durable locomotive finishing varnish.

Shorter and quicker methods are not reliable or recommended, except for re-painting and repair work. (30 pp., 3 figs. *pd.*)

CORPS OF ENGINEERS, UNITED STATES ARMY

Professional Memoirs, vol. 7, no. 31, January-February 1915, Washington Barracks, D. C.

Percolation and Upward Pressure of Water, Capt. W. A. Mitchell.

The paper considers the action of percolation and upward water pressure is as far as it affects the design of dams, and is to a large extent based on experimental work.

Very little information has been obtained so far as to upward pressure, and although it has been known for a long time that some provision for it was necessary, no accurate allowance has been made in the past. The author investigated three fundamental subjects—adhesion, percolation and upward water pressure, as affecting the design of dams and locks, mainly on the basis of experimental work done for this particular purpose by the Ohio River Board and others. The article, though of great interest, is too long to be fully abstracted and only the author's conclusions are here reproduced.

Little or no allowance can safely be made for adhesion of concrete to concrete or of concrete to rock.

Water pressure is transmitted through concrete, though quite slowly. If allowed free exit, this pressure is practically negligible.

Water pressure is transmitted through joints between con-

crete and concrete, and is transmitted more freely than through solid concrete. The water is transmitted quite slowly and if allowed free exit, the pressure is practically negligible.

Water pressure is transmitted through joints between concrete and rock. This is generally transmitted more freely than through joints between concrete and concrete. The amount varies with different rocks. The water is transmitted quite slowly in general and if allowed free exit, the pressure is practically negligible in good rock without cracks or fissures.

Water travels in small veins in the joints between concrete and concrete, and between concrete and rock. If allowed free exit, the pressure varies irregularly between upper and lower pools. If the exit is closed, the pressure quickly becomes that of upper pool, and water rises in test holes to level of upper pool as soon as enough water has passed through the veins to fill the test holes.

The amount of space of these small veins, that is, the area of upward water pressure, varies from nearly zero in excellent granite foundations to 50 per cent or more in rotten shale. It is practically impossible to calculate this.

Water pressure is transmitted more or less freely through washed sand, gravel aggregate, and washed river gravel and hardly at all through alluvial soil.

Puddled alluvial soil has practically no water pressure, if there are any drains, but such soil quickly disintegrates with a running leak.

With a material such as alluvial soil, which offers such a great resistance to percolation as practically to prevent it, a very small number of relief holes in the slab would be sufficient to eliminate almost the upward water pressure, provided, of course, that the material were such that only percolation and no erosion would take place.

With a material offering so great a resistance to percolation as washed sand, a very small number of relief holes would greatly reduce the upward water pressure when there is no outlet at the toe of the slab.

With a slab having a free exit for water at the toe, and a row of sheet piles at the heel, the upward water pressure varies from one-third the head at the heel to one-fourth the head at the toe.

Gravel aggregate offers less resistance to percolation than the river sand, and more than the river gravel. Hence, for the same reduction of upward water pressure when there is no outlet at the toe of the slab, more relief holes will be needed than for the sand and less than for the washed gravel.

For a slab having free exit for water at the toe and a row of sheet piles at the heel, the upward water pressure varies from one-sixteenth the head at the heel to one-fortieth the head at the toe.

In a material offering such a small resistance to percolation as washed gravel, a large number of relief holes in the slab will be necessary to reduce materially the upward water pressure when there is no outlet at the toe of the slab.

With an outlet for water at the toe of the slab and a row of sheet piles at the heel, the upward water pressure varies from full head at the heel to about one-third the head at the toe.

The pressure of water with free exit, transmitted through sand, washed gravel, or gravel aggregate, is diminished greatly on entrance and more slowly, but surely, diminished along the line of travel.

Full upward pressure of water, without free exit, is transmitted quickly through washed gravel, and less quickly through gravel aggregate and sand.

Water percolates (very slowly) through concrete and rock.

There is very little percolation through alluvial soil.

Water percolates more or less freely through sand, gravel aggregate, and washed gravel.

Water creates "boils" at the toe of the foundation after the relation of head to length of travel (percolation factor) becomes a certain amount, varying for different materials. This condition is dangerous to the foundation when the velocity of exit is sufficient to carry away with it the material of the foundation. It is generally best to make this percolation factor so great that there will be no such boils.

If the percolation factor is too small (varies for different materials) the material under the foundation will blow out and the foundation will fall in. With alluvial soil, this blow-out comes with little or no previous warning by boils. (50 pp., 34 figs. *eA*).

INSTITUTION OF CIVIL ENGINEERS

Advance paper, session of 1914-1915, no. 2

Tests of Reinforced Concrete Structures on the Great Central Railway, J. B. Ball (abstracted)

Corrosion of Steel Wharves at Kowloon, S. H. Ellis (abstracted)

Concreting in Freezing Weather, and the Effect of Frost upon Concrete, John Hammersley-Heenan

TESTS OF REINFORCED CONCRETE STRUCTURES ON THE GREAT CENTRAL RAILWAY, J. B. Hall.

Data of tests of reinforced concrete structures on the Great Central Railway, such as an overbridge, a bridge carrying a new road and tramway, four high level railway bridges, and foundations and pits for engine shed.

In the case of the overbridge, the entire superstructure is reinforced with round bars on the Hennebique system; the abutments at each end are of mass concrete but the piers are braced and reinforced. Both tensile and compressive reinforcements were used in all the beams, the percentage of reinforcement in the main girders being exceptionally high on account of the area available in the compression flange. The bridge was tested with a dead load of 1 cwt. per square foot and a rolling load of two 16 ton traction engines, each hauling a lorry loaded with pig iron to a weight of 32 tons, or a total moving load of 96 tons. In all cases, the recovery was complete after the load was removed. The working stresses were limited to 700 lb. per sq. in. maximum compressive stress on the concrete, and 16,000 lb. per sq. in. tensile stress on the reinforcement.

In the reinforced concrete bridge carrying a road and a tramway for the Grimsby District Light Railway, the percentage of reinforcement ranges from 0.60 per cent in the cross beams to 4.67 per cent in the outer main beams of the longer span. The bridge was tested with two moving tramcars and no appreciable deflection was reported on any of the beams. It was designed to allow for the passage of two 40 ton boiler-trollies drawn by a 5 ton traction engine, the portion of the bridge not covered by moving loads being loaded with 1 cwt. per square foot. In computing the stress, the various members were taken as being freely supported

and no allowance was made for the continuity of the beams, or for the fixity of the ends, the allowable working stress being the same as in the case of the previous bridge.

In the reinforced concrete foundations and pits for the engine shed at Inningham dock, the work consists of a reinforced concrete raft so spread that the load upon the ground nowhere exceeds 10 cwt. per square foot, and the engine pits form part of the raft. Reinforced tie beams are provided every 60 ft. between the pits, and Kahn bars are used throughout in the reinforcements of this work. (4 pp. *d*).

Corrosion of Steel Wharves at Kowloon, S. H. Ellis.

Description of steel wharves at Kowloon, Hong Kong Harbor, British possessions in China, and the corrosion of same.

In 1906, in connection with the reconstruction of a wharf an examination was made of some steel piles, which had been in place for about four years, and they were found to be corroded in a curious manner. Any steel immersed in sea water at Hong Kong becomes quickly coated with barnacles and other shell-fish, and with a dense vegetable growth, particularly very near the surface of the water down to 15 ft. or so below it. It has been an accepted theory that this growth protects the metal and prevents rusting, but when the growth which had been scraped away from the pile was examined, it was found that a large number of pits had formed in the surface of the steel varying in size up to 1¼ in. in diameter and 3 in. deep. They were found full of a black carbonaceous powder, which was found also in a thin layer on the surface of the unpitted steel and, on exposure to the air turned to a dark red color. On analysis, it was found to be sulphide of iron and its change of color was due to oxidation. Apparently some particular shell-fish or marine growth attached to the piles produces large quantities of sulphide of hydrogen when dead and decayed, and this sulphide of hydrogen attacks the metal. It is evident that when once this process is started, the deposit of sulphide favors more rapid corrosion beneath it. The destructive effects of this kind appear to be confined to the part between low water level and 15 ft. below it, the zone of the worst corrosion extending from 5 ft. to 10 ft. below low water level.

It was eventually decided to incase the whole of the new structure in concrete and have the other wharves bare steel painted with anticorrosive composition on erection. Since this was done the superstructure and the piles above low water level have been scraped and painted annually and the steel has been kept in fair condition with no mark of deterioration except once, when a longer period than twelve months was allowed to elapse between recoatings. The yearly cost of maintenance is about £100 for a total deck area of 34,000 sq. ft. Two years after completion, pitting had commenced on the under water surface of the piles, the construction coating of paint having then almost disappeared and a thick layer of shells and marine growth had become attached to the metal.

The author describes in detail the method used in incasing the piles with concrete, a minimum cover of 2½ in. of Portland cement concrete of standard quality being provided to the steel throughout. After the whole of the work had been completed about a year, and the bulk of it for about two years, the author made an inspection of the wharf and was unable to detect any sign of deterioration on the surface, but he did not cut into the concrete. Three years later obvious indications of corrosion within became apparent on the surface of the concrete and a thorough examination of the whole structure revealed that above high water level corrosion appeared to have gone on almost unchecked by the presence of the concrete covering, and a thickness of about 1/16 in. of rust scale was found on all the steel members in this zone on their under and outer sides.

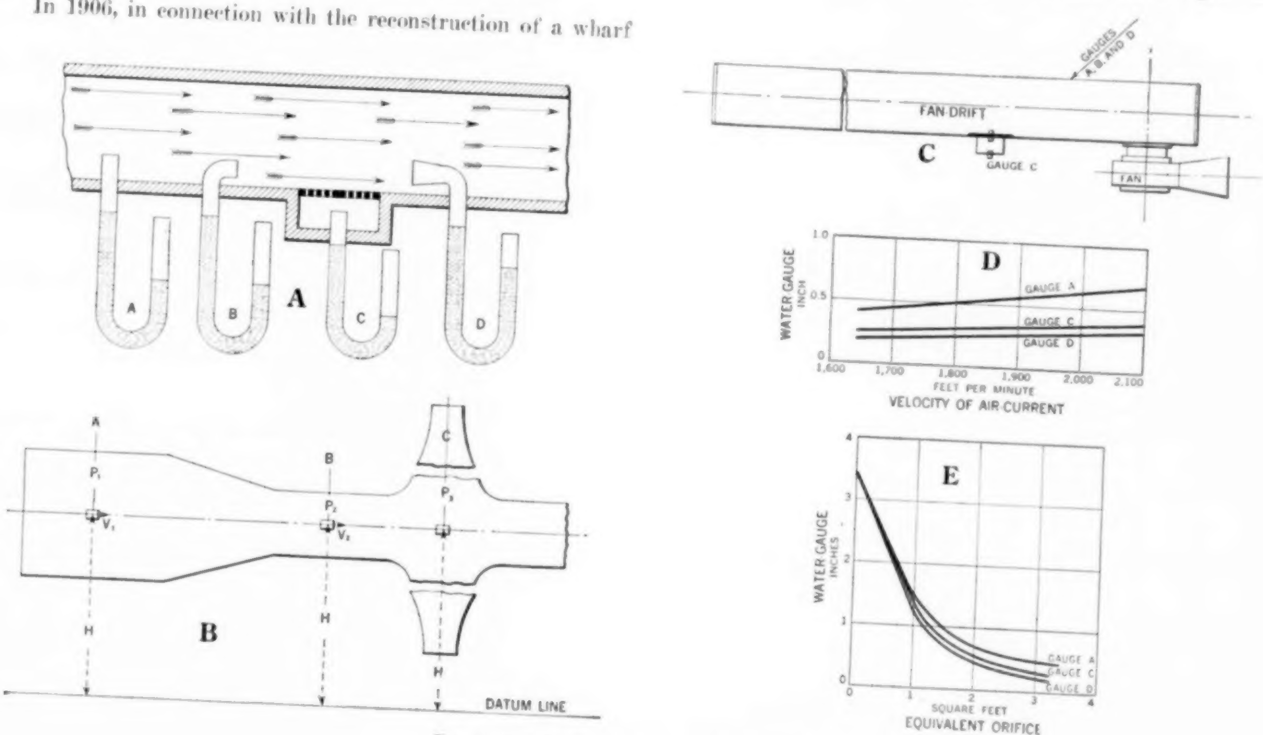


Fig. 7 Fan Test Curves and Water Gages

The author concludes that while steel protected by concrete has little or no tendency to corrode if it becomes thoroughly wet twice in the twenty-four years, yet when it is continually exposed to air damp from the evaporation of sea water, especially in a tropical climate, some other external coating must be sought, either as an addition to the concrete or in place of it. Curiously enough the corrosive effects of damp salt air appear to be limited to a zone immediately above the surface of the water. Steel work, both exposed and embedded in concrete, in warehouses on the same property has not been found to be affected.

INSTITUTION OF MINING ENGINEERS

Transactions, vol. 48, part 1, November 1914, London.

The Rosehall Signal-Indicator, James Black
The Testing of Fans, with Special Reference to the Measurement of Pressure, Thomas Bryson (abstracted)
Substitutes for Wooden Supports in Coal Mines
Tests on False (or Split) Links for Cut-Chain Braes, John T. Wight

The Testing of Fans, with Special Reference to the Measurement of Pressure, Thomas Bryson.

Discussion of the question of reliability of fan tests and determination of various factors in the expression of mechanical efficiency with special respect to the exact determination of the height of the water gage.

The writer bases his specification for a water gage on the principle of conservation of energy as applied to measurement of pressure and proceeds to the discussion of the position and form of the water gage. While it is generally agreed that the water gage should, in addition to being placed at the entrance to the fan, be measured also at the ear of the fan, there is nothing unanimous with regard to its precise position. If *D*, Fig. 7A, be the correct form, it may be placed anywhere near the fan—even in the ear of the fan, but if *C* be used, it may be most conveniently placed near the ear of the fan on the wall of the drift. If the gage be placed in the ear of the fan, error is bound to arise from varying velocities, due to eddying currents, but if a gage of the form *C* be placed on the wall of the drift near the fan, and separated from the drift by a partition in which there is a capillary connection, it is most likely that the pressure registered will be effected by air currents, since the interior of the box will be a zone of reduced pressure in which there would be no appreciable movement of the air. The condition of the air in the box will be quite the same as that of the air at section *C* in the drift (Fig. B); consequently, a gage of the ordinary form, fitted to such a box, would register exhaustion only.

The writer has recently made some experiments to test his conclusions with regard to the various forms of water gages. The following data are typical of the results obtained: Experiment No. 1 was carried out for the purpose of determining what pressures would be registered by gages of the forms *A, B, C* and *D,* attached to the fan drift, when no air was allowed to pass through the fan drift, it being closed at the end. Relative position of the fan, fan drift and gage are shown in Fig. C. The results obtained after a number of speeds of the fan are shown in a table. Another series of experiments was made to establish a relationship between gages of the forms *A, C* and *D* for the various velocities of the air passing the drift. A constant opening was maintained at the end of the drift, the change of velocity being obtained by altering the speed of the ventilator. The results of this test can be seen from the curves in Fig. D. In the third series of tests, pressures were registered over a greater range of velocities than in the preceding series and the opening at the end of the drift varied, in order to obtain a series of "equivalent orifices." The results from this experiment are given in the original article in the form of a table, and are shown here by the curves in Fig. E.

From these tests, it appeared that at least three forms of the tube terminations *A, B* and *D,* were not scientifically correct. It was shown that the value of P_3 (Fig. B) at section *C* would be greater than either P_1 or P_2 at sections *A* and *B* respectively. Further, pressure registered by a water gage situated in the zone of reduced pressure, separated from the fan drift by a partition having a capillary connection in it, is greater than the section registered by a Pitot tube. If, however, the velocities are small, there is little difference between the readings given by *C* and *D,* but there is considerable difference between them at high velocities such

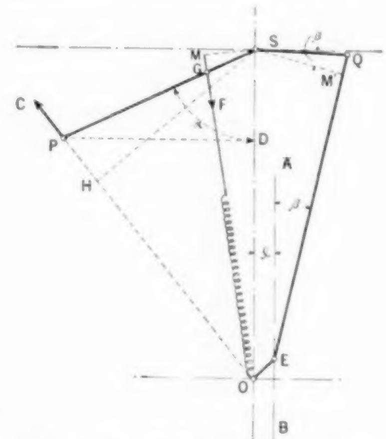


Fig. 8 Diagram of a Shaft Governor

as 960 revolutions of the fan per minute, and velocity of air 1,600 ft. per minute.

In the discussion which followed, Wm. Davidson of Glasgow stated that recently he had had the experience of doubling the quantity of air in a mine by putting down a larger fan and when the fan was tested, in the first instance, difficulty was experienced in finding the proper water gage. No matter how the end of the tube was placed in the fan drift, there were different readings, indicating that something was wrong with the method. A method similar to that described in the above paper, however, was the only one tried. A steady reading was obtained and it was from that reading that the figures were worked out for the new fan. In building a fan drift for the new ventilator, a small manhole was inserted in the side with a steel door, having very small perforations. The end of the water gage was turned into that. The results from the new fan were very satisfactory. (6 pp., 5 figs. *e.*)

KYOTO IMPERIAL UNIVERSITY, COLLEGE OF ENGINEERING

Memoirs, vol. 1, no. 1, August 1914, Kyoto, Japan

Disturbing Actions of a Shaft Governor, Genjiro Hamabe.

The paper is devoted to a consideration of the disturbing actions of a shaft governor applied to a steam engine as its

speed regulator. It reports an investigation of the laws of these disturbing motions, considers the statical conditions of the governor and gives a method of designing it in connection therewith.

In the case of a conical pendulum governor, the forces at the sleeve required for overcoming the resistance of the regulating gear when a movement of the sleeve is commenced, may be regarded as constant in magnitude. The case is quite different in a shaft governor. Most shaft governors in practical use are attached to the fly-wheel, the eccentric disk being held in position by the governor and on this account, a comparatively large amount of the resistance of the valve gear continually reacts on the governor. Fluctuating and reversing periodically, according to the position of the crank, these forces cause the pendulum of the governor to vibrate about its position of equilibrium and this vibratory motion may cause a false distribution of steam. Further, when the load on the engine is altered, the relative configuration of the governor changes accordingly and the pendulum moves from one position of equilibrium to another.

On account of the inertia of the pendulum and the parts connected therewith, this change of configuration is sometimes accompanied by a number of vibratory motions which cause a serious disturbance of steam distribution. Fig. 8 is a diagrammatic sketch of a shaft governor showing about one-half of the governor. It is attached to and rotates as usual with the crank shaft O, consisting of a pair of pendulums arranged symmetrically with respect to O, with its fulcrum at S and its center of gravity at P; a spring F attached at G and passing through O connects the pendulums. There is a centrifugal force C at each pendulum so as to throw it out against the force of the spring F. The pendulum has a lever SQ on the opposite side of S and the end Q of this lever is connected with the eccentric center E by means of a rod QE. In order to keep the lead of the valve constant, the eccentric center is assumed to be guided so as to move along a straight line AB, perpendicular to the center line of the crank. After the engine is unloaded, either suddenly or gradually, the speed of the engine increases, the pendulum flies out owing to the corresponding increase of the centrifugal force and the steam is cut off earlier than would have been otherwise the case.

If there were no vibratory motions of the governor, the pendulum would be at rest with respect to the flywheel in a steady working condition of the engine; consequently all moments of force, acting at several points of the pendulum would be in equilibrium and for the equilibrium of the pendulum about this fulcrum S, the following three moments must form a balancing set; the moment of the centrifugal force of the pendulum acting clockwise; the moment of force of the spring acting counter-clockwise and the moment of the mean reacting force of the valve gear acting counter-clockwise. The first moment depends on the angular velocity and the position of the pendulum: the second and third moments, on the position of the pendulum only. The author gives equations for the determination of these three moments as well as an equation of the state of equilibrium of the governor, and from this equation can be found the values of the moment of centrifugal force of the pendulum at different positions and the characteristic curve of the governor can be drawn. The irregularity of the governor can be found from the curve. Conversely, assuming the value of principal irregularity of the governor, we can determine the dimensions of the governor spring from the equation.

The author gives examples of the application of these equations, such as that of a vertical single cylinder 10 in. x 10 in. fitted with a piston valve 4.33 in. in diameter, running at 240 r.p.m., under a pressure of 6 atmospheres absolute and regulated by a shaft governor mounted on the crank shaft. He goes through the entire calculation and gives the characteristic curves of the governors which, under certain limitations, would be used on such an engine. This part of the article is not suitable for abstracting.

He proceeds then to an investigation of the vibration of the pendulum caused by periodic changes of the reacting forces of the valve gear, and treats the subject in a strictly mathematical manner. From the results of calculation he finds that the vibration of the pendulum caused by the reacting forces of the valve gear rises to a degree which is inadmissible in a regulator. If one tries, as with the conical governor, to make the "energy" so great that reacting forces may be inappreciable, a disproportionately heavier governor is necessitated and we have to remain content with the governor accompanied by vibrations which are damped in practice by frictional resistance at pins or at knife edges which was not taken into account in the deduction of the equation of motion; or some device must be perfected whereby to suppress these vibrations. Since in a conical governor the chief source of vibrations is the unsteadiness due to the finite mass of the flywheel, they may be removed by fulfilling the condition that the insensibility of the governor should not be less than the unsteadiness of the flywheel, but in a shaft governor, which is a pure spring governor, the vibrations are caused by the reacting forces as well as by the influence of the unsteadiness of the flywheel and meeting only the latter condition, would not sufficiently remedy the evil. To obviate this, a shaft governor is often provided with a dash pot or oil brake.

The author next investigates the mechanical motion of the pendulum when the load on the engine changes and finds the equations which show this. In several examples, he shows the manner in which the governors approach their new position of equilibrium, some of them coming to it sooner or later with the approaching motion accompanied or not by some oscillation, but without any over regulation at all, while in all other cases, the governors make over regulation in different degrees, all, however, come practically to rest after some interval of time in the new position of equilibrium. On the whole, the author concludes that the governors which are found by means of their characteristic curves to be stable, do not necessarily come to their new position of equilibrium. In other words, a governor not fulfilling the conditions established by one of the equations found by the author and having no constant friction is of an unsteady character, while some governors may be defective on account of over regulation or hunting. Moreover, if a governor be constructed so as to obviate these defects, too steady a governor may result, which requires a longer time for its displacement; such a governor is again unfit for practical use.

An interesting part of the above paper not presented in the abstract is the mathematical treatment of the subject and the characteristic curves of the governors reproduced in the paper.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

Transactions, vol. 30, part 6, December 1914, Newcastle-on-Tyne.

A Review of the Progress in the Marine Steam Engine on the North-East Coast During the Last Fifteen Years, A. C. Ross

Charging of Two-Cycle Engines, Professor B. Hopkinson (abstracted)

A New Type of Internal Combustion Engine, H. F. Fullagar (abstracted)

The Charging of Two-Cycle Internal Combustion Engines, B. Hopkinson.

The paper discusses the subject of charging of two-cycle internal combustion engines and takes up the effect of stratification on the performance of the engine. It includes also tests on the Fullagar engine.

The performance of two-cycle internal combustion engines is determined very largely by the efficiency of the process of charging. In view of the very short time given for replacing the gases of combustion by a fresh charge, some mixing in-

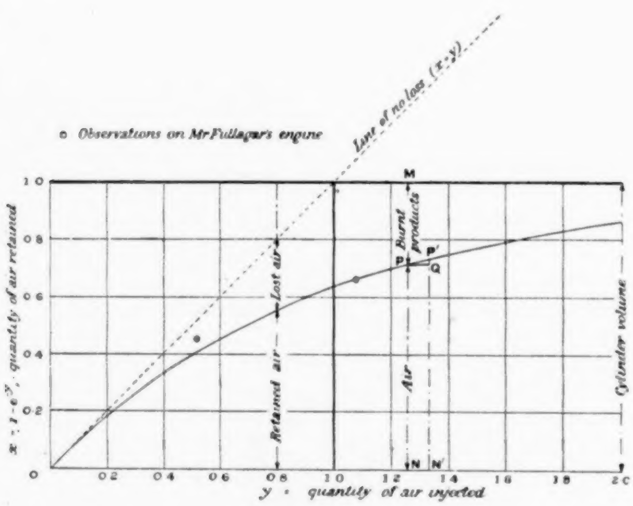


Fig. 9 Charging Curves of Fullagar Engine

evitably takes place and some of the fresh charge or of the scavenger air passes away to the exhaust and is wasted. The waste of fuel affects the economy of the engine as well as the size of the charging pumps, which must be large enough to deliver the whole charge of gas and air, including that which is wasted.

The author stated that he was struck by the almost complete absence of data of general application on which to base, in the case of a new design, the calculation of the size of pumps required to give a certain mean pressure and a prediction of the economy which may be expected. Little or nothing has been published as to the amount of the loss to exhaust which occurs in exhausting engines, and there is no theory to guide designers in the use of such data as exist on this point or may become available.

In the course of the charging process, for each unit of volume of air or mixture which enters at the inlet, an equal volume of the gas near to the exhaust ports will be driven out through those ports. The gas will consist partly of burned products and partly of air which is mixed with the products. Denote by z, the proportion of air by volume contained in the exhaust gases at the point close to the ports at any stage of the charging (z is not the volumetric proportion determined by ordinary analysis but the volume reckoned at atmospheric pressure and at the temperature of the air as it comes in, contained in a cubic foot, the balance of $1-z$ consisting of burned products from the previous explosion, whose volume is for this purpose reckoned at the temperature of those products before charging began). Obviously z will increase from zero as the charging goes on and will approach but never reach the value unity. The total amount of air lost in charging will be equal to the volume delivered, z, multiplied by the average value of z and is readily calculable if this quantity is known at every stage. The mass of air retained in the cylinder is equal to y minus the loss, and this will be denoted by x.

Two cases admit of very simple treatment. The first is the ideal case of perfect stratification where the air simply drives the burnt gases before it without mixing with them at all and there is no loss at all until the amount of air exceeds the cylinder volume,—a condition which is never even approached in practice; and the second case is more nearly what actually happens,—instead of complete stratification there is no stratification at all, mixing being so complete that the cylinder contents are at every instant of uniform composition throughout. Here the quantity z represents not only the proportion of air in the gas which is going into the exhaust at any stage, but also the proportion then present in the cylinder as a whole. For the sake of convenience, as unit of volume, is taken the whole of the cylinder volume of air maintained in the cylinder, which also represents the proportion of air in the whole cylinder contents so that in the case now under consideration z equals x. In Fig. 9, x is plotted against y, the amount (in cylinder volume) of air which has been injected. When the amount ON has been injected, the air present in the cylinder is PN, the remainder PN being the burned products. The effect of adding the further dose of air NN' is to expel at the exhaust, the quantity of air $\frac{PN}{MN} \times NN'$. The balance remains in the cylinder, increasing the quantity of air there by $P'Q = \frac{PM}{MN} \times NN'$, and the curve can be constructed in this way step by step. It is an exponential curve, whose slope at any point is equal to the ordinate PM. The relation between x and y is $X = 1 - e^{y}$. In short stroke Diesel engines with valves in the cylinder cover, the mixing is probably fairly complete. In engines having relatively longer cylinders, there is some stratification of the cylinder, but even there, not very much.

The main tests of the author were made on the Fullagar engine (described in the next abstract). In it, the air ports communicated with a large receiver to which air was delivered by an electrically driven fan. Coal gas was used in these trials and was admitted by a piston valve at the center of the cylinder, being delivered at high pressure by a reciprocating pump. For the verification of the formula above given were required the accurate measurements of, first, the total capacity of air delivered to the engine per minute and, second, the proportion of that air retained in the cylinder. To measure the quantity of air, a diaphragm with a circular hole was inserted in the air delivery pipe between the fan and the engine and the drop of pressure was measured by

means of a water gage. The diameter of the air pipe was 18 in.; that of the hole in the diaphragm 9 in. The current of air through the diaphragm was nearly uniform because of the pulsations of the engine being nearly damped out by the large air receiver. The velocity of the air through the hole was calculated according to the usual formula, assuming 0.62 as the coefficient of discharge. The author believes that the quantity of air delivered to the engine was probably determined correctly within three per cent; the coal gas was also metered.

For determining the proportion of air retained, samples were taken of the contents of all four cylinders and analyzed. After absorbing the CO_2 the combustion of the residue was completed over palladium and the further yield of CO_2 obtained. The total CO_2 gave the proportion of coal gas to air in the cylinder contents. Simultaneous analyses of the exhaust gases gave the proportion of coal gas to air delivered to the engine, a check being obtained by estimating the oxygen in the exhaust and in the cylinder contents. The results obtained showed that there is a rough agreement between the calculated and measured figures—sufficient at any rate to justify the use of the simple supposition of complete mixing as the first approximation of what occurs. On the other hand, the deviation with smaller amounts of air is too great to be ascribed to errors of observation, the observed loss of air being only about two-thirds of the calculated loss which shows that there are disturbing factors which must be taken into account as corrections to this simple theory. One of such factors is the effect of stratification, the portions near the exhaust ports being poorer in air and richer in burned products than the average. In addition to that, there is also in all cases some throttling in the exhaust ports and exhaust pipe as well as inertia effects in the exhaust pipe in consequence of which the pressure in the cylinder varies during the admission period.

In the discussion which followed and which referred to both papers (Professor Hopkinson's and Mr. Fullagar's), Mr. J. W. B. Stokes pointed out that the waste of charging air is a field which cannot very well be avoided. If it were attempted to cut down this charge of air to the minimum quantity or to have no loss at all,—at any rate through the exhaust ports,—there would be a very great danger of some of the fresh gas making contact with the products of combustion, which would lead to a back fire. Therefore, for the safe working of the engine, scavenging becomes necessary. He described an experiment he tried with an engine in which the air loss was cut down to the lowest possible figure,—in fact, there was no scavenging air sent forward at all, but it was touch and go with explosions at the right moment of preignition. The speaker further objected to the measurement of air in Professor Hopkinson's experiment by means of a diaphragm, as a possible error might be nearer 30 per cent than 3 per cent. In regard to the discontinuance of building the Oechelhauser engines by William Beardmore & Sons Company, Ltd., of Glasgow, which attracted considerable attention in England, the speaker, who is connected with that firm, stated that the reason for this was not that the engine was unreliable but that it cost too much to build it.

Alan E. L. Chorlton expressed his disappointment at the fact that Professor Hopkinson did not give any particular data taken from engines actually in use. He objected also to the statement that the imperfection of the charging process was probably in a large measure responsible for the fact that 2-stroke engines have been unable to compete successfully in small sizes, with the 4-stroke cycle, and believes that there are not sufficient data available to make such a broad statement. (30 pp., 6 figs. *eA*).

A New Type of Internal Combustion Engine, H. F. Fullagar.

Description, somewhat incomplete, of the construction and operation of the Fullagar gas engine.

The Fullagar engine has been designed to overcome the

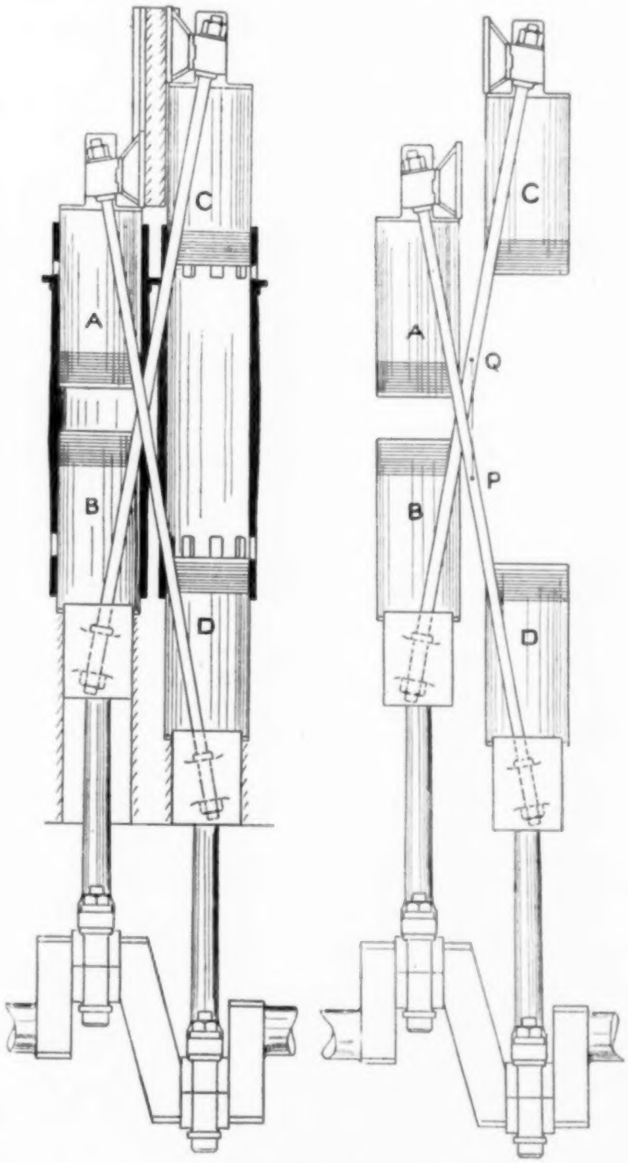


Fig. 10 Fullagar Engine

difficulties which are claimed to be in the way of increasing the size of gas engines: first, that the heat per unit of surface radiated by the flame to the cylinder walls increases with the size of the cylinder, while the thickness of the metal through which this heat has to reach the cooling water also increases; second, that the weight per h.p. increases with the size of the cylinder, and third, that the useless forces are called into play (useless in that they are either stationary

and do no work or even produce negative work). The Fullagar engine shown in Figs. 10 A and B, uses as a unit two open-ended cylinders, side by side, each with two pistons, and rigidily connects A to D and C to B by means of pairs of oblique rods external to the cylinder.

The action of the engine is as follows: when an explosion takes place between A and B, it drives B down and A up, drawing up D by the oblique rods, and giving, through the two connecting rods, two equal and opposite impulses to the cranks. The obliquity of the rods is small,—less than the obliquity of the connecting rods, so that the friction is actually less than would be the case if each piston had its own crank and connecting rods, and the mechanical efficiency of the engine is high. At the end of their strokes, the pistons uncover inlet and exhaust ports in the cylinder walls,—the engine working on the two-stroke cycle. Air is supplied to the cylinder by low pressure air pumps which can be driven from the engine by side levers in the ordinary way. In engines of the light high speed type, the upper cross-heads and guides are formed to act as air pumps, thus effecting a further saving of space and width. Stationary engines will usually comprise two units, making four cylinders, while more cylinders may be added for very large powers or where the height is limited.

With this construction, it is claimed that useless forces are avoided or at least greatly reduced. There are no cylinder covers nor any high pressure joints in the engine; no vertical stresses on the framing of the engine at all, the pressure of the explosion being entirely taken between the steel bars shown in Fig. B, the cross-head, oblique rods, connecting rods and crank shaft, and only the secondary reactions of the slippers, from 1/5 to 1/20 of the explosion forces, reach the framing of the engine in a horizontal direction.

The fluid pressure in each cylinder acts at every moment equally on the two cranks and the main bearings are thus relieved of practically all load except for the weight of the parts. The action of the explosion in driving apart the pistons A and B, drawn together by means of the oblique rods, the pistons C and D, compressing the charge between them so that the negative work of compression is performed not through the cranks and connecting rods but directly through the oblique rods and only the net useful work is transmitted to the crank shaft. Further, as each stroke includes compression and explosion, the reciprocating parts are cushioned at each end of every stroke, the combined effect of ignition and cushioning having for their purpose the keeping of the oblique rods in constant tension as well as making the crank effort more uniform.

The balance of the engine is practically perfect. The center of gravity of a pair of pistons, Figs. B, A and D for instance, is at the point P and moves up and down on the line PQ, while the center of gravity of the other pair is at the point Q and moves down and up on the same line. The author claims that this is probably the only engine in which the centers of gravity of the balancing masses have the same identical locus. If the forces working in this mechanism be divided into two rough classes, which, for the purpose of brief description, the author calls "useful" and "useless," the only ones falling into the latter class are the minor reactions from the slippers at the end of the oblique rods, constant in direction and less, both in number and amount, than the similar reactions of any other reciprocating engine in common use, whether gas or steam.

In regard to weight, the new construction, by combining eight two-stroke pistons with four cranks, produces a given power upon 1/2 to 1/3 the weight required with other constructions. From a heat point of view, the double type of cylinder has material advantages, and further, such cylinders require but one crank each. In form, the cylinder is a plain tube, supported at either end but free to expand axially and with its fellows is surrounded by a common tank forming the water jacket. In such a cylinder, temperature stresses cannot occur and moreover, in the absence of corners or pockets, the actual mean temperature of the inner surface of the cylinder is very low.

To test the system, an engine of 500 h.p. was built and installed in the engine room of the Newcastle Electric Supply Company. It is of the stationary type and weighs, without the flywheel, under 20 tons. As it develops continuously some 550 b.h.p., its weight is less than one-half of that of gas engines of equal power. A very interesting feature is the ease of repairs. An upper piston can be withdrawn in ten minutes after stopping the engine and the lower piston lifted out through the cylinder in three minutes more. The whole of the eight pistons can be withdrawn in an hour with the use of a hand crane only. In spite of the fact that the air and gas supply auxiliaries are somewhat of a make-shift in character, the over-all efficiency during a 30 hour test was found by Professor Hopkinson to be just under 30 per cent, with the indicated efficiency 37.6 per cent, and the mechanical efficiency about 90 per cent. The chief interest of the system is claimed to be in the promise it holds out of much larger powers with fewer and lower stresses.

In the discussion which followed, Richard W. Alan took up the question of the use of oblique rods in the Fullagar engine. At first, he was somewhat uncertain about the vibration of the rods and in order to safeguard against any accident which might arise out of these oblique rods, a special form has been constructed in which the rods were placed both with the top and bottom pistons; a hydraulic pressure of 50 tons applied to the rods gave only an extremely small deflection. To insure freedom from vibration, vertical guides have been placed on the oblique rods, which have a damping effect and in actual practice they experience no trouble whatever.

UNIVERSITY OF ILLINOIS

Bulletin, vol. 12, no. 10, November 9, 1914, Urbana, Ill.

The Analysis of Coal with Phenol as a Solvent, S. W. Parr and H. F. Hadley.

Report of work done at the Engineering Experiment Station of the University of Illinois, treating of a method of coal analysis in which the cellulose and rosinic substances are separated by means of a solvent, the main solvent used in this investigation was phenol. While the paper does not contain a regular bibliography in the subject, it gives numerous references to previous investigations and an interesting historical sketch of coal analysis.

The purpose of this method of analysis is to separate in unaltered form the fundamental substances of which coal is composed and to study their characteristic properties in detail. By this means, it has become possible to study separately the insoluble residue and the extracted matter; to de-

termine which has the greater avidity for oxygen, and to which division belong the coking constituents and special products of decomposition, such as gas, illuminants and tar.

This is therefore of particular importance to the gas and coal tar products industries.

It was found that phenol at 212 deg. fahr. will dissolve constituents of bituminous coals in their natural states and that the two sub-divisions designated respectively as insoluble residue and extracted matter together make substantially 100 per cent of the amount of the original substance. Studies upon these two type substances indicate that the extract is the vital constituent concerned in the coking of coal, that it has a sufficiently definite melting point, and a decomposition temperature which is above that of the melting point.

Each sub-division is capable of absorbing oxygen, but the insoluble portion has the greater avidity for it. The effect of absorbing oxygen upon the extract is to modify its coking properties by lowering or greatly reducing its power to form a firm and coherent mass. The oxygen taken up in either case is found to be chemically combined and the oxygen taken up by fresh coal is similarly held.

Previous work has shown that oxidation was playing an important role in producing changes in the residue and extract. It was desired, therefore, to establish whether the loss of coking properties was due to oxidation or simple absorption of oxygen as well as to see what effect the heating at 105 deg. cent. (221 deg. fahr.) would have on the percentage of volatile matter. Coal was heated therefore in air at the above temperature for different lengths of time and volatile matter determinations were made at successive stages of oxidation, and it was found that the volatile matter decreased with progressive heating and that the decrease in volatile matter was more rapid in the case of the coal which had the higher percentage in the beginning. It was found also that residue and extract possess an avidity for oxygen, the residue showing the greater avidity. The ultimate analysis of the coal residue and extract show that the percentages in both of carbon, hydrogen, nitrogen and oxygen are substantially the same. (41 pp., 6 figs. *cp.*)

SOCIETY AND LIBRARY AFFAIRS

MEETINGS

BOSTON, JANUARY 6

The meeting of the Boston Section on January 6 was devoted to the subject of Aviation. Albert Adams Merrill discussed the problem of fore and aft stability. He said that as long ago as 1871, the French aviator, M. Penaud, had shown the value of the longitudinal dihedral, composed of two surfaces, the front one being the main supporting surface and the rear one being a non-lifting tail. The dihedral was obtained by making the angle of incidence of the front surface greater than the angle of incidence of the tail, which in the Penaud models had a negative angle.

The trouble with all cambered surfaces is that the center of pressure moves in the wrong direction with a change in the angle of incidence within the limits of flying angles, but by using two surfaces with a longitudinal dihedral between them, the movement of the center of pressure of the system can be altered so as to get any desired movement. Practically all machines get their dihedral between the supporting surfaces and a non-lifting tail. Mr. Merrill claims this is not the best way for two reasons. First, because the tail is not a weight carrier and hence wastes power, and second, because the horizontal gap between the tail and the main surface produces a time lag in the introduction of the righting couple which is bound to set up oscillations about the lateral axis. To overcome this, Mr. Merrill designed a biplane in which the top surface is ahead of the lower surface and the chords are not parallel, the angle of the front being greater than that of the rear. Such a machine is called a converging staggered biplane. With this design the dihedral exists between the two supporting surfaces and no tail is necessary. Such a machine was built and flown during the last summer, first as a land machine and then over water. With this design, it is possible to get any desired movement of the center of pressure of the system. Mr. Merrill illustrated his talk with blackboard designs and small paper flying models.

Greely S. Curtis, of the Burgess Company of Marblehead, presented a number of interesting slides showing aeroplanes in flight and also showed a number of charts. He mentioned that during 1914, there had been little advance in speed or duration of flight, the speed record standing at approximately 123 miles per hour. In regard to inherent stability, many experiments had been made with the Dunne machine and with the Dunne-Burgess type at Marblehead, which practically eliminate stalling and diving and require but little manipulation of hand control levers governing the stability. Mr. Curtis showed cuts of the Sperry gyroscope stabilizer.

Prof. Joseph C. Riley, of the Massachusetts Institute of Technology, showed many lantern slides of gasoline engines including four, six and eight cylinder models. He stated that a four cylinder model won the foreign competition prize in 1912 for a seven hour test. Later in the British competition, no engine with less than six cylinders was allowed to enter. He called particular attention to the Bentz engine which has proved so economical. He pointed out the trouble in balancing a four cylinder engine to do away with vibration and called attention to the advantages of six and eight cylinder designs. He also showed illustrations of the rotary types and mentioning particularly the Gnome.

The attendance at this meeting was about 125.

BUFFALO, JANUARY 7

A meeting of the Buffalo Engineering Society was held on January 7. The meeting was addressed by Prof. J. A. Moyer of the Pennsylvania State College who spoke on Recent Development in Steam Turbine Engineering. After giving somewhat of a history of the early development of the steam engine, he gave a full and complete explanation of the new mercury turbine which is now being developed at Schenectady. There was some spirited discussion of

Prof. Moyer's paper. The attendance at the meeting was about 160.

CHICAGO, JANUARY 8

A meeting of the Chicago Section to which the members of the Western Railway Club were invited was held on January 8. The speakers of the evening were R. M. Ostermann and Clement F. Street who covered the subjects of superheaters and mechanical stokers respectively and Willard A. Smith, president of the Railway Review, who spoke of Railway Economics.

In discussing superheaters, Mr. Ostermann explained concisely, with the aid of stereopticon views, the construction of the superheater and cited by means of diagrams, the results of tests showing the nature and extent of the economies derived from the use of this apparatus.

Robert Quayle discussed the superheater experience of the Chicago and Northwestern Railway which has in use, 425 superheater locomotives. From the shop and round house point of view, importance was laid on the possibility of suppressing steam leaks and keeping the flues open for the ready passage of the gases around the superheater units. An experimental equipment containing a pyrometer has been installed in some cases indicating to the men in the cabs, the temperature of the steam at all times passing through the cylinders, and in this way suggesting such defects in manipulation as holes through the fire, excessive thickness of fuel bed, steam leaks in the front end or in the operative damper. In regard to lubrication, difficulties have been overcome to a large extent by getting the enginemen into the habit of running on cracked throttle whenever the engine is not running under power, and this made possible the general return to the usual grades of valve oil instead of the more expensive kinds that at first were thought necessary. While the fuel savings vary with the intelligence and alertness of the engine crews, on the average they are believed to amount to twenty per cent of the amount required by non-superheater engines. The saving in water consumption was such that switchers were found to be able to work nearly fifty per cent longer on a given amount of water than they did before superheaters were applied.

The boiler pressures now prevailing on superheater locomotives of the Chicago and Northwestern Railway are thirty pounds less than on the non-superheater motive power and this together with the adopted practice of regularly assigning crews to engines may have been the cause of the fact that the direct maintenance expense was found not to be appreciably greater than similar expense on the non-superheater class. Superheater equipment has also proved very popular with the men.

In regard to mechanical stokers, Mr. Street spoke of the magnitude of the railway industry and the influence exercised on it by the efficiency movement in the use of the coal in the firebox of the locomotive.

H. T. Bentley of the Chicago and Northwestern Railway stated that his road has not yet felt a real necessity for stoker equipment partly because its locomotives are relatively small and also on account of the fact that the labor of the firemen has been greatly reduced through the use of coal pushers, for the purpose of delivering the coal to the forward end of the tender and within easy reach of the firing deck.

This was followed by a series of answers given by Mr. Street to questions raised by the audience. One of the statements made in this way was that by the use of the stoker in one instance, slack at 60 to 75 cents per ton has been successfully fired in competition with run of mine, hand fired, costing from \$1.20 to \$1.50 per ton, and at the same time with improvements to the ability to handle traffic.

In the discussion of the subject of Railway Economics, Willard A. Smith, of the Railway Review, Chicago, cited the evident trend of affairs in regard to maintenance of equipment costs resulting from the extended use of high capacity cars and locomotives. Numerous figures were cited to indicate this condition, not the least impressive of these was that had a reduction of ten per cent been made in the maintenance of equipment costs on the roads of this country for the last fiscal year, it would have made possible the doubling of the dividends paid and also that were the seemingly plausible saving of 20 per cent to be made in the maintenance of equipment costs on the basis of last year's returns, the dividends could be quadrupled. At the rate maintenance of equipment expense has been increasing during the past ten years, it is to be anticipated that in five years, this item will represent as large an expenditure as does operating expense. On some roads, maintenance of equipment costs already exceed those of operation. On other roads this expense is greater than the entire passenger revenue. On others, locomotive maintenance alone costs 25 per cent more than those roads expend for fuel. Since 1900 the average tractive power of locomotives has increased 36 per cent while the cost or maintenance to those locomotives has increased 93 per cent. The average freight car capacity in the same period has increased 34 per cent, the average load 28 per cent, while the freight car maintenance costs have advanced 67 per cent. Freight car maintenance costs have so far advanced that they now amount to approximately two and one-third times fuel and locomotive maintenance costs combined.

As a possible means of solution to the problem which the railroads are confronting in this connection, it was suggested by Mr. Smith that there be established a national bureau of railway engineering whose functions would be to investigate conditions as to nature and capacity of equipment, roadbed, terminal facilities, etc., and render to the roads seeking its services such recommendations in each case as the country's best engineering, and administrative talent and experience could afford. In Mr. Smith's opinion, a bureau of this nature might properly be established in one of three ways, enumerated herewith in the order of their preference: First, a governmental bureau, for which ample precedence is afforded in the Department of Agriculture and in the Bureau of Mines; second, by private endowment, an action which not a few individuals or establishments having achieved their success through the patronage of the roads of this country, could well afford to take with lasting benefit to the roads and distinction for themselves; and third, through a commission to be created by the roads on their own responsibility, to be supported by them jointly and to render an impartial service to all roads alike. This latter plan, it is believed, would constitute an important initial step in any event, since such an organization should have no difficulty in attracting attention to the very valuable results to be derived from the work in which it would become engaged and thereupon should have no great difficulty in enlisting governmental or other outside support.

At the conclusion of Mr. Smith's remarks, Dr. W. F. M. Goss, whose presence had been anticipated during the discussion of the technical subjects earlier in the evening, was introduced, but owing to the lateness of the hour, he made only a few remarks.

This account is abstracted from the report given in the Railway Review, January 16, 1915.

ST. LOUIS, JANUARY 11

The Annual Meeting and Dinner of the St. Louis Section were held on the evening of January 16 at which Chairman Bausch acted as toastmaster. The speakers were Edward Flad, Consulting Engineer and Member of the Board of Freeholders; E. R. Kinsey, President of the Board of Public Service; Joseph A. Hook, Director of Public Utilities, Board of Public Service and E. R. Fish, Secretary of the Heine Safety Boiler Company.

Mr. Flad told of the framing of the New Charter for the City of St. Louis and particularly of the things in it of interest to engineers, dwelling especially on the board of efficiency, the introduction of the merit system in the hiring of city employees, and the concentration of power and responsibility in a board of public service consisting of five members, the president, and two members who must be engineers of at least ten years' experience.

Mr. Kinsey told of the scope of the duties of the Board of Public Service and how splendidly the provisions of the New Charter in regard to this board were working out. Under the New Charter, there has been an entire reorganization and separation of the departments each being placed under the supervision of specialists.

Mr. Hook spoke of some of the problems of his department, particularly that of the Free Bridge and the River Terminals, and asked the coöperation of the members. Suggestions were offered by Messrs. Boughton, Hibbard, Hunter, Kinsey, Satz, Flad, Nordmeyer and Wadleigh.

Messrs. Wadleigh, Seubert and Hunter gave brief reports of the St. Paul-Minneapolis meeting and Mr. Fish gave a report of the Annual Meeting.

NEW YORK, JANUARY 15

The New York meeting for January was held on the 15th of the month instead of the usual second Tuesday. A lecture was given by T. Kennard Thomson, D.Sc., consulting engineer, on A Really Greater New York. The lecture dealt in the main with the mechanical problems connected with the building of foundations for tall buildings and bridges particularly where caissons are required. Dr. Thomson showed many views of the foundation work in New York City, both past and present, of some of the best known buildings and explained in detail the many problems connected with the use of compressed air in caissons especially where as is the case in Manhattan, foundations must be carried to a great depth. The subject matter of the lecture naturally led to a discussion in conclusion of the possibility of a greater New York acquired through the construction of new land extending into the harbor and the East River with new transportation channels. This means that a greater increase of shore front could be secured to accommodate greater ocean traffic together with the facilities for handling freight including warehouses and other buildings.

PHILADELPHIA, JANUARY 14

A joint meeting of the Philadelphia Section with the Metallurgical Section of the Franklin Institute was held on January 14 with Prof. H. E. Ehlers and Prof. A. E. Outerbridge jointly presiding. Robert R. Abbott, Metallurgical Engineer for the Peerless Motor Car Company, presented a paper on Modern Steels and Their Heat Treatment. After considering the mixtures and compounds of iron and carbon present in steels, the proportions of these contained in steels of different carbon contents and their influence upon the strength of the material as indicated by percentage reduction in area in tension, the speaker described the effect upon the iron-carbon constituents produced by alloying with iron other elements such as nickel, chromium, manganese, etc. He then compared with this latter, the effects produced by heat treatment, showing that such effects were practically the same as those produced by alloying. He concluded with an outline of the commercial applications of heat-treated steel. The speaker illustrated his remarks by means of lantern slides of photo-micrographs and charts.

The paper was discussed by Prof. A. E. Outerbridge, Prof. Edgar Marburg, G. R. Henderson, H. V. Wille, Dr. Carl Hering, H. A. F. Campbell, E. W. Finkbiner, J. T. Fennell, and others.

CINCINNATI, JANUARY 21

A joint meeting with the Engineers' Club of Cincinnati was held on January 21. R. W. Rew of the Department of Public Service of Cincinnati spoke on the Engineering Features of the Proposed Rapid Transit System. About 100 members and guests were present.

NECROLOGY

HERBERT NICHOLAS FENNER

Herbert Nicholas Fenner was born in Providence, R. I. on March 13, 1843. He obtained his early education in that city and after a few years experience in business, he succeeded his father in the New England Butt Company. He served as treasurer of that company for many years and at the time of his death was president. He was also a Director in the Industrial Trust Company and the Joslin Manufacturing Company.

Mr. Fenner took a great interest in public affairs, but never held political office. He was prominent in club life and was a director of the Puritan Life Insurance Company.

He died in Providence, R. I., on January 5.

HERBERT SELBY HAYWOOD

Herbert Selby Haywood was born at Brooklyn, N. Y., on September 19, 1845. His parents moved to Elizabeth, N. J. in 1852 and he was educated at Rev. David H. Pierson's school in that city. In 1862, he entered the Novelty Iron Works in New York City and served a four years apprenticeship in marine construction work and engineering. In July 1866, he entered the service of the Pacific Mail Steamship Company and made a voyage on the Steamship "Montana" through the Strait of Magellan to San Francisco. On several other long trips during the years 1866 to 1872, he filled positions as 2nd and 1st assistant and acting chief engineer. For about four years, he was detailed to service on branch lines on a steamer plying between ports in Japan, China and the Siberian Coast.

In April, 1873, he entered the service of the Pennsylvania Railroad Company as machinist in the Altoona shops. In 1874 he was detailed for special duty on the United Railroads of N. J. division as Assistant Road Foreman of Engines. He was appointed Assistant Superintendent of Motive Power in 1875 to which the marine department was added in 1881. In 1882, he was appointed Superintendent of Motive Power of this same division and also of the United Railroads of N. J. Division in 1883 and of the Camden and Atlantic R. R. including the ferries and floating equipment on the Delaware River in 1884. He had supervision of the motive power and marine equipment of the New York, Philadelphia and Norfolk Railroad from January 1, 1890 until his death.

During the 80's, he took out several patents, including an interior check valve on a locomotive boiler, one for a car journal box and another, a cut off valve for a beam engine. This cut off valve was adopted by practically all of the ferries in New York harbor.

Mr. Haywood was one of the oldest members of the Society having become a member in 1880. He was also a member of the Society of Naval Architects and Marine Engineers, the Engineers' Club of New York, the Engineers' Club of Philadelphia and the New York Railroad Club. He died December 14, 1914.

CHARLES A. MOORE

Charles A. Moore, President of Manning, Maxwell and Moore, Inc., New York, was born at Sparta, N. Y. nearly 70 years ago. When he was 12 years old, he went to Lynn, Mass. to live with an uncle and receive his education. In 1862, he enlisted in the United States Navy and served until the end of the Civil War.

Fifteen years of his early business life were spent in and about Boston. During this time, he was connected with the Ashcroft Manufacturing Company and the Consolidated Safety Valve Company in the manufacture of steam specialities.

Mr. Moore later came to New York to be with H. S. Manning & Co. In 1881, the firm name was changed to Manning, Maxwell and Moore. At Mr. Maxwell's death in 1895, the business was left in the hands of Messrs. Manning and Moore. Mr. Manning retired in 1905.

In his busy years, Mr. Moore was very active in Republican politics. He was President of the American Protective Tariff League, and one of the founders and for ten years president of the Montauk Club in Brooklyn, N. Y., a member of the New York Chamber of Commerce, and the National Association of Manufacturers and several other societies and clubs. Mr. Moore died on December 8, 1914.

FRANK RUSSELL PACKHAM

Frank Russell Packham was born at Hadley, Michigan on May 11, 1855. He received his early education in Canada and his first business training with his father who was a miller. He also served an apprenticeship in a sewing machine factory and learned the machine and pattern making trades.

When he was 18 years old, his parents moved to Springfield, Ohio, where Mr. Packham was employed as a machinist for the Wardell-Mitchell Company which is now a part of the International Harvester Company.

In 1878, he became superintendent and experimental man for the Baker Drill Company in Mechanicsburg, Ohio, and manager and designer of turner's tools for the Packham Crimper Co. until 1886.

In 1887, he returned to Springfield and identified himself with the Superior Drill Company devoting his time to designing and pattern making.

Upon the formation of the American Seeding Machine Company, Mr. Packham was made a director of the company and manager of the experimental department. This position, he held until the time of his death.

As an inventor, Mr. Packham contributed as many as 150 improvements on various agricultural implements, most of which are now manufactured by the American Seeding Machine Company. Probably his most important work was the invention and development of the "single disc" drill.

In 1900, Mr. Packham was appointed by Secretary Wilson as a representative of the United States Government to tour the world in the interests of the Foreign and Domestic Bureau of Commerce. In 1909, he was appointed mechanical guide to the Honorable Commercial Commission of Japan in its visit to this country.

Mr. Packham died at Springfield, Ohio, on January 1.

WILLIAM R. ECKART

William R. Eckart was born in Chillicothe, Ohio, June 17, 1841. His relatives were pioneers in the settlement of that part of the State, but in 1842 his family moved to Cleveland, where his father had large shipping interests on the Great Lakes. His early education began in private schools, but from the time he was twelve years old his school days were divided between the public schools of Chillicothe and Cleveland. Later, he took a special course in mathematics at the St. Clair Street Academy, Cleveland, with the view of becoming a civil engineer.

In the early fifties his father removed to Zanesville to engage in the operation of a flour mill, operated by water power, and after the installation of some improved water wheels, Mr. Eckart received the opportunity to serve an apprenticeship in the works of Griffith, Ebert and Wedge, which in those days, had a high reputation for general mill and steamboat work; this was a welcome opportunity as the fascination of steamboat work had taken hold of his ambition while traveling on the Ohio and Mississippi rivers. In his apprenticeship he was fortunate in having the friendship and guidance of Mr. Wedge, who found the time to show him how to improve upon his work after he had thought it "good enough."

Mr. Eckart's river experience aroused a desire for naval life, and in June, 1861, he took an examination before the Board of Engineers. On July 30, when he was twenty years of age, he was appointed Third Assistant Engineer in the navy and was ordered at once to join the fleet of naval vessels on the Pacific coast. On July 10, 1864, Mr. Eckart resigned from the navy on account of ill health and took up his residence in San Francisco, where he began work in the drawing room of H. J. Booth and Company. While with this company, he made the designs and drawings for the first California built locomotive. He remained with this company until February, 1869, when he received an appointment as draftsman in the Steam Engineering Department at Mare Island Navy Yard. He was afterwards made foreman machinist and later was promoted to superintendent of steam machinery through B. F. Isherwood's recommendation.

In 1871 Mr. Eckart left the Navy Yard to enter into partnership with Prescott, Scheidel and Company, at the Marysville Foundry. The firm name was later changed to Booth and Eckart. It was while there that Mr. Eckart contracted for, designed and built the steamer Meteor for the Carson Lumber Company, with a guaranteed speed of 21 miles per hour; this steamer was used on Lake Tahoe and was probably the fastest boat of her size known at that date.

In 1876 Mr. Eckart was recalled by the Prescott, Scott and Company, who were the successors to H. J. Booth and Company, to superintend the construction and assist in designing and erecting some pumping machinery for the Comstock Lode. About this time he moved to Virginia City to become consulting engineer to the "Bonanza Firm" that owned or controlled nearly all of the "North End" Mines. During this time he was manager of the Fulton Foundry, Virginia City. In 1878 he was appointed U. S. Deputy Mineral Surveyor for the State of Nevada. While still a resident at Virgina City he designed and built, in connection with W. I. Sakeld, a noted millwright at that time, the Bulwer Standard Mill, at Bodie, which was one of the largest pan mills for working ore that had been built at that time.

During the early part of 1880, Mr. Eckart was appointed a member of the U. S. Geological Survey under Clarence King and was given charge of investigating and reporting upon the mechanical appliances of the Comstock Lode. On this work, which was really a labor of love, he spent nearly two years collecting data, testing pumps, engines and hoists, and making drawings for the Government of all the machinery on the Comstock. The finest instruments procurable in the United States and Europe were used in the various investigations of efficiency.

In 1881, Mr. Eckart removed to San Francisco and opened offices there as a consulting and constructing engineer, and during the following eight or ten years some of the largest and most important mining plants were designed and constructed under his supervision. The pumping engine for the Ontario Mine, with perhaps the largest Cornish pumps for deep mining ever built in the United States, were constructed from his designs during this period. In 1881, he began for Haggin and Tevis, plans for all of the Anaconda Works, hoists and reduction works, and during the next seven years, all their mining work and mills were designed by him.

In 1883, The Union Iron Works, formerly Prescott, Scott and Company, was changed to an incorporated company and Mr. Eckart was retained as consulting engineer in matters pertaining to the propelling power of the Government vessels built by that company. He was present at and assisted in conducting nearly all the preliminary and government trials of these vessels.

In 1899, he was appointed consulting engineer to the Standard Electric Company and afterward became the resident construction engineer for all their hydraulic works, including storage, reservoir, ditches, dams, flumes, pipe lines and power house installations. This was the first or among the first of the long distance, high-potential-transmission, hydraulic plants projected.

Mr. Eckart was a member of the American Society of Civil Engineers, The Institution of Mechanical Engineers, The Society of Naval Architects and Marine Engineers and an Associate Member of the Institute of Naval Architects. He was Vice-President of this Society from 1883 to 1886.

Mr. Eckart died at the home of his son, in Palo Alta, Cal., on December 8, 1914, after a very successful engineering career covering a period of fifty years' practice on the Pacific coast, which, as he once said, was due "to a studious life surrounded by an extensive collected engineering library of American and foreign books and the appreciative assistance of associated engineers, together with the encouragement and loyalty of employers."

PERSONALS

Louis H. Mesker has accepted a position with the sales department of The Kearney & Trecker Company, Milwaukee, Wis. He was until recently connected with the Anderson Forge and Machine Company, Detroit, Mich.

Henrik Greger, recently associated with the Epping Carpenter Pump Company, Pittsburgh, Pa., as assistant chief engineer, has become affiliated with The Prescott Company, Menominee, Mich., as mechanical engineer.

Alfred W. Charles has accepted the position of chief draftsman with the Canadian Copper Company, Copper Cliff, Ont., Canada. He was formerly connected with the Anaconda Copper Mining Company, Butte, Mont., in the same capacity.

Russell B. Bedford until recently President of the Railway Material Export Corporation, New York, has assumed the position of export manager and manager of the Eastern branch of the Clarage Foundry and Manufacturing Company, Kalamazoo, Mich., with headquarters in New York. He is also engaged in personal consulting engineering work.

Arthur G. McKee has lately formed a corporation with his two business associates, Robert E. Baker and Donald F. Herr under the name of Arthur G. McKee and Company.

Henry Souther, Chairman of the Standards Committee of the Society of Automobile Engineers, has been made a life member of that Society in recognition of his distinguished achievement in the orderly development of the art of automobile engineering. At the Annual Meeting of that Society, Mr. Souther was presented by his associates with a silver piece suitably engraved, as a token of the admiration and affection in which he is held.

H. C. Spaulding has severed his connection with the Society for Electrical Development and is now connected with the Frank Presbrey Company organizing their electrical service department.

Edward M. Hagar was appointed Honorary Vice President to represent the Society at the American Road Builders' Association in Chicago at its Eleventh Annual Convention, December 14-18, 1914. This convention was held in conjunction with the Sixth Good Roads Show. The commercial exhibits included samples used in road construction and maintenance, such as stone, gravel, asphalt, tars and brick, together with exhibits illustrating the various exhibits employed in the testing of road material; sections of patented pavements and pavements built with patented materials; construction equipment varying from tools to heavy machines; models of contractor's equipment, engineering and testing instruments.

In the arena of the amphitheatre in which the show was held an oval boulevard was laid out surrounding a park which was set with trees, and contained a gravel walk and a fountain. The boulevard proper was constructed of various types of paving materials, such as asphalt, macadam, brick, wood blocks, concrete, tar, macadam, and asphaltic concrete. The exhibits bordering the parkway were those of the Bureau of Streets of the cities of Chicago, New York, Philadelphia and Boston, and of the State Highway Commissions of Illinois, Michigan, Iowa, Arizona, Washington, Kansas, Kentucky, New York, Virginia, Rhode Island and

Maine and of the North Carolina Geological and Economic Survey. In addition, the United States Government was represented by a very interesting exhibit from the office of Public Roads of the Department of Agriculture, and Canada, by an exhibit from the Highway Commission of Ontario.

STUDENT BRANCHES

CARNEGIE INSTITUTE OF TECHNOLOGY

At a meeting of the Carnegie Institute of Technology Student Branch on January 13, E. H. Bickeley, C.I.T. '09 read a paper on some of the things he had learned and done since he left Carnegie Institute, and made the following suggestions to the students: know your materials; learn from the practical man; everything we do, think or say has a cost; what you cannot produce quickly is not your own; what you can produce quickly is what you are valued at.

Mr. Bickeley then told of some of his work at the H. J. Heinz plant at Pittsburgh. He cited a number of instances to show how wastes had been eliminated and explained his system of card indexes and curves which he used in keeping track of the various operations going on in the plant. For instance, in a department where water or compressed air is being used, meters are put in the line. A report is received from the foreman of the department and this is plotted on the curve. A rise in the curve immediately denotes that there is something wrong.

The speaker then described his invention, the motorgraph which is an electrical sign on which the letter forming words appear at the right side of the sign and move across the face, disappearing on the left side. The lettering and motion is controlled by a moving perforated strip of paper and because of this simple control, changes in the lettering can be made almost instantly, and a continuous stream of different reading matter can be flashed across the sign.

COLORADO AGRICULTURAL COLLEGE

At a meeting of the Colorado Agricultural College Student Branch on November 19, the following officers were elected; A. T. Johnson, chairman; W. K. Morrison, vice-chairman; and T. H. Sackett, secretary-treasurer. A programme committee was appointed consisting of the chairman, vice-chairman and the secretary.

At a meeting on November 23, the progress of Oxy-Acetylene Welding was reviewed by E. S. Murray and Standardizing Machinery was discussed by W. K. Morrison.

On December 7, Recent Developments in the Diesel Engine, by H. R. Setz was discussed.

At a meeting held on January 4, Prof. Albert Cammack gave an extemporaneous talk on Tool Steels. He outlined briefly the history of the development of tool steel, speaking particularly upon the tests, use and manufacture of modern high speed steels. He discussed hardening and tempering steels and the economy resulting in the employment of the high speed steels.

KANSAS STATE AGRICULTURAL COLLEGE

At a meeting of the Kansas State Agricultural College Student Branch on January 14, Prof. S. L. Simmering of the mechanical engineering department gave a paper on Manufacturing Wire Nails. From the ore as taken from the mine, Mr. Simmering told of its progress through the plant until it comes out a finished product. When the ore is first received, it is run through the crusher and a sample for chemical analysis is taken from each lot and from this, the amount of impurities is determined. In making up a charge for the blast furnace, the ores are mixed in proportions so that the resulting iron will be within the allowable limit of impurities. The iron is taken from the blast furnace to the Bessemer converters and made into steel, which steel is cast into ingots and then rolled to a square about four by four in. and cut into twenty-four inch lengths. These blocks are then heated and rolled to a three-eighths in. rod. This rod from the rolling mill is coiled in bundles the same as wire, heated and annealed in lime. It is then cold drawn to the size required for the nail. One machine makes the complete nail.

KANSAS UNIVERSITY

At the regular meeting of the Kansas University Student Branch, on January 7, S. E. Campbell discussed an article on Cost Accounting by William Kent which appeared in Industrial Engineering. He spoke principally upon its economic value in large plants rather than upon methods of keeping cost accounts.

Dean P. F. Walker, Honorary Chairman of the branch, spoke briefly on the Annual Meeting at New York. He gave a general outline of the whole meeting, explaining how it was conducted and touched slightly upon some of the papers given.

At a meeting on January 14, Dean Walker continued his talk and spoke of the purpose and value of engineering societies of all branches to the engineering profession. Although he spoke more specifically of the Am. Soc. M. E., he gave briefly the histories of many other important engineering societies such as the American Society of Civil Engineers and the American Institute of Electrical Engineers.

LEHIGH UNIVERSITY

Prof. Thomas E. Butterfield and a party of Seniors from Lehigh University visited New York during the week January 4-9 on their annual tour of inspection of large engineering plants. A visit was made to the Engineering Societies Building, where the students were shown the Library with its wealth of engineering and scientific literature, the headquarters of the Mining, Electrical and Mechanical Engineering societies and the Museum of Safety, where there is a permanent exhibit of all types of safety appliances.

All students who intend to live in New York upon graduation are invited to make the Society their headquarters and avail themselves of the Library and other privileges.

STEVENS INSTITUTE OF TECHNOLOGY

The Student Branch at Stevens Institute of Technology held its second lecture on December 15. J. I. Lyle, General Manager of the Carrier Air Conditioning Company gave a very interesting talk on Air Conditioning, giving examples of many of the applications of drying and humidifying air in the industries. The talk was appreciated because it dealt with subjects with which all of the hearers were conversant and because it was treated clearly and concisely. Views of air conditioning apparatus as used in its applications, were used as illustrations.

Another lecture was held on January 5. The speakers were I. E. Moultrop, superintendent of construction for the Boston Edison Company and J. W. Parker, assistant superintendent of operation of the same compaany. Mr. Moultrop gave a brief outline of the history of the company, describing its original equipment contrasting it with that of the present plant. He also enumerated the various items to be considered in choosing a site for a power plant. Mr. Parker told how the responsibility for each part of the work was divided among the men, and how the welfare of the workmen was taken care of. He also described the company's method of handling their peak load. Both speakers illustrated their talks with lantern slides.

UNIVERSITY OF CINCINNATI

At a meeting of the University of Cincinnati Student Branch on January 15, B. S. Hughes of Steigner, Hughes and Alvez, Consulting engineers, gave a lecture on The Problems of a Consulting Engineer. As an illustration of the conditions which may confront the consulting engineer, Mr. Hughes assumed that he was to build a power plant with a certain capacity and that the expense item was no object. For a plant which would be operated under these conditions, under a scientific management, and with a skillful staff, it would be advisable to install a high grade system of units, and probably include all of the modern heat-saving appliances. If, however, the plant was not to be

operated under scientific management, it would be advisable to install units of lower initial cost.

Mr. Hughes cited several examples which illustrated the various conditions affecting the design and operation of power plants. He mentioned the equipment of steam power plants with condensing units, where live steam was used for drying purposes in the factory which was an obvious waste of funds for initial cost and operation. Another case in which an important item was overlooked was that of the large paper mills in the South which were splendidly designed from an engineering standpoint, but which were surrounded by such unattractive local conditions that good men could not be induced to stay.

At the close of the paper, Prof. A. L. Jenkins, of the University of Cincinnati, and others informally discussed the paper.

UNIVERSITY OF COLORADO

At a meeting of the University of Colorado Student Branch on January 14, R. N. Robertson, mechanical engineer of the American Smelting and Refining Company, spoke on Boiler Setting and the Altitude Effect. Mr. Robertson discussed rather fully the matter of boiler settings for different coals used at various altitudes. He brought out the principle points in connection with combustion under these conditions, giving the qualities of various coals and their relation to the design of furnaces. The speaker said that the altitude is a very important factor in combustion. About 50 per cent increase must be made in the flues and combustion chamber and 75 per cent increase in the height of the stack to cause the proper draft for complete combustion with the rarified air at altitudes of two miles or more.

Mr. Robertson showed some new designs of settings and results from his own experience with soft coals in the company furnace, and some new points on combustion. The speaker believes that the under-feed is the best form of stoker for all purposes and all conditions and that there is no doubt that it is coming to be the prevailing form.

UNIVERSITY OF MISSOURI

The University of Missouri Student Branch held a meeting on December 17, at which Stanley Goodman and P. R. A. Nolting read and discussed their paper on The Effect of Various Constituents of Coal upon the Fusing Point of its Ash.

At a meeting on January 10, F. N. Westcott read a descriptive paper on the St. Louis Water Works System, and F. P. Hutchinson read a paper on Smoke Prevention.

EMPLOYMENT BULLETIN

Note: In sending applications stamps should be enclosed for forwarding.

The Secretary considers it a special obligation and pleasant duty to be the medium of securing positions for members, and is pleased to receive requests both for positions and for men. The published notices of "men available" are made up from members of the Society. Notices are not repeated except upon special request. Names and records are kept on the office list three months, and if desired must be renewed at the end of such period. Copy for the Bulletin must be in hand before the 12th of the month.

POSITIONS AVAILABLE

010 Mechanical engineer as assistant superintendent for cement mill. New York State. Applicant should have a technical education as well as practical experience, and must have demonstrated his ability to handle men efficiently. One who has had cement mill experience preferred, and competent and willing to make a study of the repair costs. Salary $150.00 per month. Apply through Society.

011 Man capable of superintending power and plant and assisting production superintendent in large cement manufactory. Salary rate $150.00 per month. Location New England.

013 Assistant superintendent for chemical manufacturing plant in Middle West employing 1500 men. Chemical education and experience in handling men and machinery required; applicant please state age, education, previous experience, salary received heretofore and salary desired.

014 Mechanical engineer with good designing ability and large experience in conveying machinery to take charge of drafting and engineering department of company manufacturing conveying machinery. Give experience, references, salary expected and full particulars which will be treated strictly confidentially. Location Middle West.

015. Chief draftsman, man experienced in the design and manufacture of sheet metal products such as office furniture, filing cases, and similar equipment, competent to systematize and direct the work of thirty to forty men. Give age, education, experience, references, and the salary expected. New York concern.

019 Laboratory instructor. Salary beginning at $1500 per year with excellent opportunity for promotion. Location Nevada.

020 Resident engineer on construction and extension of cement plant in Tennessee. Salary between $150 and $200 per month. Apply through Society.

021 Good designing draftsman, experienced in designing automatic paper forming machinery such as envelope or paper box machinery, and one who has had several years of machine shop training. Location New York.

022 District representative wanted in one of the large Middle West cities to handle steam turbine account. Applicant must have had experience in steam engineering practice and the application of turbines, turbo-pump sets, turbo-generator sets and turbo-blower sets, and the sales ability necessary to the successful handling of the account. Apply through the Society.

023 Foundry and machine shop located in Metropolitan district wishes services of technical man with about ten to twenty thousand dollars to invest. Apply through Society.

024 Young man for work in efficiency department of middle west concern, with shop experience and possibly some experience in efficiency work. Will require a man with initiative. Applicants state in detail experience and give the approximate salary that would be considered. Names of former employers should be included.

025 General foreman of large machine shop manufacturing large generators and other work of a kindred character. Apply through Society.

026 Wanted party with capital to assist in financing the development of important improvements in the design and application of hydro-pneumatic apparatus.

029 An engineer of established reputation on the Pacific Coast desires partner with capital to form a corporation to engage in general engineering and contracting business. One who has had previous experience or technical knowledge and ability to get business. New York interview desired.

030 Agency wanted for small patented electrical device of foreign invention. Apply by number.

031 First-class designer in concern in New York State making paper printing, and book machinery, etc.

032 Large manufacturing company with modern steel working equipment and complete organization, has capacity larger than at present required. Will be pleased to hear from parties desiring the manufacture of their products. Apply through Society.

033 High grade shipping clerk to take charge of the output of a firm employing 750 men at the present time working night and day. Would consider only man thoroughly experienced. Location Connecticut.

036 Man to take charge of a foundry, machine shop and blacksmith shop now in course of erection; not necessary that he be a craftsman, but rather a good handler of men and with a knowledge of cost accounts, etc. Establishment is for repair work for large iron mines. Apply by number.

MEN AVAILABLE

B-1 Junior, graduate M.I.T., mechanical engineer, age 30, married, five and one half years experience in design and construction of power plants and illumination of textile mills, sales of electro power, and preparation of contracts, desires position in engineer's office as assistant to manager, superintendent of a cotton mill, master mechanic or purchasing agent.

B-2 Junior, technical graduate in mechanical and electrical engineering, ten years experience in design, construction, operation and maintenance of power house and sub-stations, high voltage electric design, piping design and layouts, etc., and building designs, desires position as power engineer, assistant superintendent of large mill, or designing engineer for large engineering firm or contractor.

B-3 Mechanical engineer, five years experience in design and reproduction of agricultural and marine gas and oil engines, one year in charge of mechanical and of a new food product, desires responsible position in production or sales department.

B-4 Member, 12 years experience in designing, as superintendent of construction, as transit man, in transmission, purchasing, shipments and office details, as operating superintendent of 3000 barrel cement plant, connected with plants in the East, Middle West and Central South, desires to connect with responsible firm. Location immaterial.

B-5 Mechanical engineer, well qualified by technical education, experienced in research along lines of engineering physics, desires position involving industrial research or experimental engineering. Would also consider position as salesman on the road.

B-6 Member, graduate mechanical engineer, age 34, 11 years successful experience in designing, manufacturing, experimental and sales engineering; gas and oil engines of small and medium sizes, gas and electric hoists and draw bridge machinery, gas and oil tractors, railroad water service, coal and ore unloading dredge machinery. Well qualified for position as chief draftsman, experimental or production engineer or assistant superintendent. Practical and resourceful in economic methods of manufacture.

B-7 Member with well established office in New York desires to correspond with responsible concerns in regard to representation.

B-8 Associate member, graduate M.E., 1910, age 33, three years experience teaching and two of practical experience, has ability to superintend and increase efficiency of production. At present employed as assistant superintendent of small factory, desires position along similar lines, or will consider other opportunities in mechanical engineering; would also accept teaching position.

B-9 Member, technical graduate, 15 years experience supervising design and construction of power plants, office and factory buildings, mechanical equipment and fire protection systems, drawing specifications and contracts, desires position along similar lines, or with consulting engineer. At present employed by large industrial corporation in administrative engineering capacity.

B-10 Member, 25 years experience in mechanical, electrical and automobile work, thoroughly up-to-date in economical manufacture and time saving methods, desires position as manager, mechanical engineer or salesman.

B-11 Mechanical engineer, technical graduate, age 30, thorough knowledge of all types of pumps and pumping machinery, gasolene and oil engines, sugar house machinery, drawing room, erection room, and engineering department, desires responsible position, sugar plantation work in Mexico or sales engineer in Brazil.

B-12 Member, 30 years experience in hydraulic forging machinery and other heavy machines for the manipulation of metal, desires position as designing adviser or executive along these lines. Can be engaged for part time if desirable.

B-13 Member, age 34, technical graduate, 11 years experience in mill engineering and central station work consisting of designing, drawing up specifications, buying equipment, supervising installation, managing operation and maintenance, good executive and accustomed to handling high grade men, desires position as works engineer or with consulting engineer. At present employed.

B-14 Engineer with ten years experience in building up sales organizations, factory improvements in paper mills, tanneries, chemical works, metal working plants, machine tool building, clothing industries, etc., and having established large consulting practice in management engineering for a firm of industrial advisers, desires position with similar engineering or accounting firm.

B-15 Electrical and mechanical engineer, graduate University of Illinois, 1901, post graduate, 1910-1911, E.E. and M.S., 13 years practical experience in testing, design, construction, operation and management of steam, electric and hydro-electric plants, including generation, high-tension transmission, distribution of electric light and power for mines and cities in the United States and abroad, investigations and reports, is open for immediate engagement. Location immaterial.

B-16 Member, Stevens graduate, 25 years experience, well established record with prominent concerns, engaged in interchangeable manufacture, especially apt on tool design for large production with high degree of accuracy, successful executive in engineering and productive lines, desires position as manager, superintendent or mechanical engineer.

B-17 Graduate M.I.T. in mechanical engineering, two years experience in maintenance of power equipment, plant and designing new factory building with large manufacturing concern, two years inspecting reinforced concrete and steel structures with irrigation project, familiar with reinforced concrete design, desires position with construction firm, or power and plant department of manufacturing concern.

B-18 Cornell graduate, age 33, one and one-half years study of railroads in Germany, eight years railroad shop experience, desires position with engineering or manufacturing firm, or shop machine tool works. At present employed as practical instructor of apprentices.

B-19 Cornell graduate, age 28, married, seven years experience as machinist, toolmaker, master mechanic and chief engineer in charge of power and refrigeration plant, desires position in experimental work, testing, design or teaching mechanical engineering subjects.

B-20 Mechanical engineer, student member, 1914 graduate of large Eastern university, desires position with industrial or commercial concern.

B-21 Junior member, M.I.T. graduate, age 27, married, four and one half years experience, including drafting, power plant, textile machinery, office and executive work, desires permanent position with reliable concern offering chance for advancement.

B-22 Student member, graduate of University of Missouri, desires engineering position of any kind which offers chance for advancement.

B-23 M.I.T. graduate in mechanical engineering, nine years experience in motive power department of a large railway system, desires position with railway company in either M. P. or C. T. department. Location immaterial.

B-24 Associate-member, graduate M.I.T., associate A.I.E.E., age 26, experienced in teaching and as foreman, assistant superintendent and experimenter, desires position with manufacturer or experimenter.

B-25 Graduate engineer with ten years practical experience in power, heating and refrigerating work, including installation, design and estimating, would like to have the opportunity of doing some work while confined to his home. Has had special experience in physics, chemistry and calculus and would be willing to do editorial work in these and in engineering subjects.

B-26 Member, graduate of M.I.T., with broad experience, would like executive position, or position as assistant to chief executive in large concern. At present employed but desires change.

B-27 Mechanical and electrical engineer, graduate W.P.I., age 26, experienced in machine shop and steel mill work desires to make change. At present employed.

B-28 Superintendent or factory manager familiar with most modern practice in machine shops, foundries and manufacturing plants, competent to design tools and fixtures for increasing production and reducing costs.

B-29 Mechanical engineer, age 31, 14 years experience, desires position in engineering, sales or drafting department. Detail of education and experience furnished to those interested.

B-30 Mechanical engineer, technical graduate, age 38, 13 years experience in manufacturing lines, shop, operating, drafting, engineering, efficiency, sales including railroad, Corliss engines, gas engines and producers, saw mill, mining machinery, transmission and special machinery, complete steam and gas power plants.

B-31 Junior, mechanical engineer, Columbia graduate with varied experience desires to connect with an industrial concern, not necessarily in an engineering capacity at the start. Location immaterial.

B-32 Engineer, Stevens graduate, age 31, unmarried, capable manager, excellent designer, experienced writer of specifications, has just completed supervision of several large manufacturing plants, desires position as chief engineer for firm of industrial engineers and architects. Especially with South, location immaterial.

B-33 Member, long and valuable experience in responsible positions in design and construction, supervision of printers' machinery, thorough knowledge of field and requirements and construction of rotary web presses, folders, flat beds, offsets, electrotypes and stereotype machinery. Employed as chief draftsman.

B-34 Member, technical graduate, age 34, married, 16 years experience, including wide shop drafting room and outside experience, mainly in automobile and motor truck lines. Capable of handling advertising and publicity and engineering department at the same time as shop details and executive correspondence. Location preferred vicinity of New York.

B-35 Member, technical training, age 35, married, 14 years experience with large industrial concerns in many capacities up to superintendent is open for a position requiring the services of an engineer executive whose predominating ability is along mechanical lines and who is capable of assuming charge of the operation of the works of a large department. At present employed.

B-36 Junior member, technical training, 11 years experience, including foundry and machine shop practice, design, reorganization, construction, equipment of mill buildings and power plants, estimates, schedules of materials, building specifications and appraisals, fire service piping, sewage disposal and surveying, also as assistant on steam engine turbine and boiler tests, desires to locate permanently as mechanical engineer, assistant to engineer or works manager.

B-37 Member, sales engineer, established in New York, with a broad acquaintance in New England and Middle Atlantic States, desires to secure an additional account, preferring plant equipment or steam specialty. Salary or commission.

B-38 Member, technical graduate, 15 years shop and drafting room experience designing and superintending construction; thoroughly trained in machine shop, pattern shop and foundry work, with exceptional ability in tool designing and inventive work, desires position as instructor of machine design or with consulting engineer or manufacturer where there is opportunity for advancement. Location preferred, Eastern or Central States.

B-39 Student member, age 26, technical graduate M.E., experienced as machinist, mechanical draftsman, desires position as assistant to engineer, superintendent or manager of engineering concern. Location immaterial.

B-40 Contracting engineer, college graduate, age 40, eight years experience as contractor for steel works, furnaces and structures, desires connection with steel company or firm of contractors.

B-41 Junior member, age 28, graduate mechanical engineer, five years practical experience, last two and one half years engineer of tests of large automobile company, desires position as assistant superintendent or engineer.

B-42 Mechanical engineer thoroughly familiar with design and operation of power plants, railroad electrical engineering, shops, etc., desires position.

B-43 Graduate mechanical and electrical engineer, experienced in design and construction of machinery, building, manufacturing, systematizing, accounting, refrigeration, desires permanent position in New York.

B-44 Mechanical engineer and superintendent, 12 years experience, in present position four years. Qualified to accept position as assistant general manager, superintendent, or mechanical engineer. Now employed but would resign to accept advantageous offer.

ACCESSIONS TO THE LIBRARY

This list includes only accessions to the library of this Society. Lists of accessions to the libraries of the A. I. E. E. and A. I. M. E. can be secured on request from Calvin W. Rice, Secretary of Am. Soc. M. E.

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[1] A complete list of the officers and committees of the Society will be found in the Year Book for 1915, and in the January and July 1915 issues of The Journal